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Opinions and Practices Among Manufacturers of Cordage and Twine

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The study directors were: Rita Hausknecht and Ben L. Owens.

The Bureau of Agricultural Economics assumed major responsibility for the study, with cooperation and advice from the Agricultural Research Administration, Production and Marketing Administration, and the Bureau of Plant Industry, Soils, and Agricultural Engineering. Other Government agencies particularly helpful in developing the study were the Navy Department, the National Production Authority, and the Bureau of the Census. Industry groups who generously assisted were: The Cordage Institute, The Soft Fibre Manufacturers' Institute, The National Cotton Council, and the American Cotton Manufacturers Institute.

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FIBERS

OPINIONS AND PRACTICES AMONG MANUFACTURERS OF CORDAGE AND TWINE

Prepared under direction of the Bureau of Agricultural Economics

CONTENTS

Page

Introduction 3
- Objectives of the study 4
- How the study was developed 4

Major fibers used by the cordage and twine industry in 1951 6

Major end uses of cordage fibers 7

Opinions of manufacturers in the hard-fiber industry:
- Sisalana 14
- Henequen 18
- Abaca 23
- Synthetics 37
- Factors considered in selecting fibers for hard-fiber industry .. 39
- Special problems of the hard-fiber industry 41

Opinions of manufacturers of the soft-fiber industry:
- Jute 48
- Kenaf 52
- Cotton 55
- Hemp and flax 59
- Ramie 66
- Nylon 68
- Rayon 70
- Orlon 70
- Istle 71
- Factors considered in selecting fibers for soft-fiber industry .. 72
- Special problems of the soft-fiber industry 73

Manufacturers of cotton cordage and twine products:
- Cotton 73
- Other fibers used 85
- Nylon 88
- Rayon 90
- Orlon 91
- Factors manufacturers of cotton cordage would consider in selecting cordage fibers 92
- Special problems of manufacturers of cotton cordage 92

Appendix tables 93

SUMMARY OF MAJOR FINDINGS

More than 400 million pounds of natural fibers and close to a million pounds of synthetic fibers were used in production of cordage products during 1951.

Three fibers - sisalana, cotton, both lint and waste, and abaca - account for almost three-fourths of the total poundage used in cordage products. Two others - henequen and jute - account for most of the rest. Synthetics account for less than 1 percent of all fibers used in cordage products.

Of the total poundage, more than 4 pounds in 10 go into farm ropes and twines; more than 3 in 10 into industrial cords and twines; about 1 in 10 into household twines; and about 1 in 10 into marine cordage.

Of the total poundage used in the industry, about 3 in 5 pounds are used by hard-fiber manufacturers; more than 1 in 5 by manufacturers of cotton and synthetic cordage; and less than 1 in 5 by soft-fiber manufacturers.

Manufacturers listed their opinions as to the advantages and disadvantages of the different fibers as follows:

Sisalana (used chiefly in baler twine and as a substitute for abaca in other uses) has good tensile strength and is cheaper than abaca. But it is difficult to process; it is not as strong as abaca; and it is not thoroughly cleaned when received.

Abaca (used chiefly in marine and industrial cordage) has high tensile strength and its durability is excellent. But the methods of cleaning and grading for this fiber are not always satisfactory.

Lint cotton (used mainly in industrial cordage and twine) and cotton waste (used mainly in household twines) are priced right, according to the manufacturers. They are durable, strong enough for particular end uses, and flexible or pliable. They are attractive looking, that is, clean and white, and they are smooth. They run over pulleys smoothly and do not cut hands. Also, they are available in the market. Apparently, they have no disadvantages for the uses to which they are put.

Henequen (used chiefly in binder twines) is cheaper than either abaca or sisalana and is strong enough for particular end uses. But manufacturers found that it is not as strong as abaca and is not thoroughly cleaned when they receive it.

Jute (used chiefly in industrial cordage for wrapping and tying twines, farm rope and other twines) is cheaper than cotton or hemp and doesn't cut hands, vegetables, or vines, but it is not well cleaned when received.

Attitudes toward particular substitute fibers were as follows:

Sansiveria: The majority of the manufacturers were unfavorable toward the use of this fiber because they had found it not as strong as abaca and too expensive.

Kenaf: Opinions concerning this fiber were mixed. The main criticisms were that it is not as strong as high-grade jute, is rough and harsh and presents problems of cleaning and decorticating. But more than one in three were not familiar enough with the fiber to express an opinion.

Ramie: About half the manufacturers were unfavorable toward ramie because they thought it too expensive. About two in five were not familiar enough with it to express an opinion.

Nylon: Reactions to this fiber were mixed but favorable comments predominated. Its advantages as listed were: Its low rate of absorption; its resistance to rot and fungus growth; its high tensile strength; and its durability. Disadvantages listed were its price, the fact that it is too elastic, and that it has greater strength than is needed for most purposes.

Orlon: About one in three were not familiar enough with this fiber to express opinions, but a majority of those who did were unfavorable. Its great tensile strength was listed as an advantage, but they had found it too expensive, more like a textile than a cordage fiber, and less strong than nylon.

INTRODUCTION

In times of international conflict cordage fibers become strategic materials. Although, in general, supplies of raw fibers have moved closer to our manufacturers, all producing plantations are overseas. We are currently stock-piling abaca. But we have no way of foreseeing what the supplies of fibers available to ourselves and our allies would be in any future emergency.

The United States Department of Agriculture, in cooperation with other Federal agencies, has continued to work to improve production of abaca in Central America. In addition, experimental work is being done on production of new, substitute fibers. There is much interest in the development of processes to improve fibers already produced in this country - for example, cotton and synthetics such as rayon, nylon and orlon, for wider utilization in certain end-product uses of cordage and twine. Most of the major cordage and twine companies used substitute fibers during World War II. Results of these experiences collected for the industry as a whole, with information as to the expectations and attitudes of manufacturers toward the future development of substitute fibers will be of value to the industry, it is expected. It is also expected to be useful in any future planning to have industry-wide data for the allocation of raw fibers to various end-product uses and the quantities involved in such allocations.

In reporting the opinions and recommendations of manufacturers throughout this report, the Bureau of Agricultural Economics does not intend in any way to imply either agreement or disagreement with those opinions and recommendations. It reports them solely because a knowledge of the opinions of the manufacturers themselves may be of value to those who are interested in the cordage industry, and in the raw materials which it uses.

Objectives of the Study

The objectives of the study were:

1. To classify cordage and twine products in terms of end uses.
2. To estimate for each fiber the quantities used in various products in 1951.
3. To find out the characteristics desired in the fibers utilized in various products.
4. To find out whether the fibers currently in use have all of the characteristics desired in terms of end-product uses, and if not, to specify which characteristics are missing or need improvement.
5. To find out whether there are other fibers that would be better than those currently used.
    - (a) If so, to learn which fibers.
    - (b) To specify the reasons for not using these fibers now.
6. To find out the trend in fibers now used for various products, and to learn what substitute fibers have been used.
    - (a) To specify both the desirable and the undesirable characteristics of substitute fibers.
    - (b) To find out the industry's attitudes and expectations toward the further use of each substitute fiber.
    - (c) To specify which substitute fibers the industry has particular interest in seeing developed and the reasons for these choices.

How The Study Was Developed

Planning of the study began in April 1951. Exploratory work was started in the industry with the assistance of DeWitt Schieck of the Cordage Institute and George F. Quimby of the Soft Fibre Manufacturers' Institute. Manufacturers who generously assisted in the early phases of the study, in the pretest, and in the final study were: F. H. Filley, American Manufacturing Company; John Goble, Wall Rope Works; William Cating, Cating Rope Works; H. J. Whitlock, Whitlock Cordage Company; and William Shuster, Ederer, Inc. Daniel Himmelfarb, master rope maker at the Boston Navy Yard, also was extremely helpful during the pretest period.

Publications which the study directors found valuable in understanding the industry were Long Vegetable Fibers by Ludwig Weindling, Columbia University Press, 1947 and Utilization of Cotton and Other Materials in Cordage and Twine by Robert B. Evans and R. J. Cheatham, Bureau of Agricultural Economics, Washington, D. C., 1940.

It was desired to learn: (1) Manufacturers' opinions of the different fibers regularly used in cordage and twine products and those sometimes used as substitutes, and (2) the quantities of fibers allocated to various end uses in 1951. The data as to opinions and attitudes were collected in personal interviews, usually with company presidents. Interviewers, who were selected because of their long and varied experience and demonstrated skill with interviewing techniques, received intensive orientation and training before the study began. Interviews were scheduled in advance. These took 2 to 6 hours, depending upon the number of different fibers used by the manufacturer. The interviewing was done in the late summer and early fall of 1952.

The data on quantities of fibers used were collected on separate forms which were sometimes left with the company to be completed and mailed later. The Cordage Institute partially gathered and completely tabulated the data as to quantity for the hard-fiber industry.

With the help of members of the industry, the Bureau of the Census, and available directories, it was estimated that approximately 132 companies were manufacturing cordage and twine products in 1951. It was decided that all large companies and a sample of small companies would be included in the survey. This yielded the following results:

1. 17 hard-fiber manufacturers, a census of this segment of the industry.

2. 17 soft-fiber manufacturers, a census of jute manufacturers who were making cordage and twine products in 1951.

3. 39 manufacturers who used cotton or synthetic fibers primarily in cordage and twine products.

All quantities reported for groups 1 and 2, therefore, can be regarded as totals for the industry. But in the case of group 3, it was necessary to apply an expansion factor to the sample figures to obtain the total figures for the industry. The expansion factor used for the quantity figures on cotton was 3.28.

It was difficult to arrive at a weight for the quantity figures on synthetic fibers and those fibers infrequently used, because available information relating to small companies not contacted for interviewing was either limited or lacking entirely. In computing the factor for this group three assumptions were made: (1) Small companies are less likely to use synthetics and rare fibers, (2) small companies in the South are least likely to use synthetic fibers or those infrequently used, and (3) all small companies using synthetic and miscellaneous fibers use approximately equal quantities of each. The factor of 2.4 was computed for use in expanding the sample figures for this miscellaneous group: Nylon, rayon, orlon, silk, and flax.

Manufacturers who said they used cotton were asked to report the quantity used in 1951 in terms of lint cotton, cotton yarn, and cotton waste. The quantity of cotton yarn reported was converted to lint cotton, using a conversion factor of 0.85. The quantity of cotton waste reported used by the industry is reported separately.

MAJOR FIBERS USED BY THE CORDAGE AND TWINE INDUSTRY IN 1951 1/

Sisalana is the major fiber now utilized by the cordage and twine industry and it is the fiber used in largest quantity by hard-fiber manufacturers. Small quantities of sisalana are also used by soft-fiber manufacturers. Sisalana is an agave and is sometimes called sisal hemp.

Abaca is second in importance; it is used exclusively by the hard-fiber industry.

Lint cotton is next in order of number of pounds used and is more widely utilized than either sisalana or abaca. When the quantities of lint cotton and cotton waste going into production of cordage and twine during 1951 are combined, cotton becomes the most extensively used fiber except for sisalana.

Large quantities of henequen, which is *Agave fourcroydes* and is commonly known as Mexican or Yucatan sisal, are used by the hard-fiber industry.

Jute is the only other fiber of major importance; it is used chiefly by the soft-fiber industry, although cotton manufacturers use some jute in their cordage and twine products.

Other fibers reported, although in much smaller quantities, were hemp, istle, and flax. All three are used chiefly by the soft-fiber industry. Hemp and flax were usually reported as a mixture. Some hemp is used by hard-fiber manufacturers and some istle (pita palma, or pita floja) and flax by cotton manufacturers. Istle, like sisalana and henequen, is an agave.

The only other natural fibers reported as used by the industry in 1951 were *Urena lobata* and silk.

Among the synthetic fibers utilized, nylon was used in the largest quantity and rayon and a little orlon were reported. Nylon and rayon are both used by soft-fiber and cotton manufacturers, but orlon was reported only by cotton manufacturers (table 1).

1/ With the exception of cotton, the consumption figures in the tables are compiled from accurate records of the companies and are presented in full rather than rounded off as would be done with estimated figures.

Table 1.-Number of pounds of fibers estimated consumed by the cordage and twine industry during 1951

Fibers	Number of pounds	
Natural:		
Sisalana		120,988,213
Cotton		107,014,492
Lint cotton	77,863,758	
Cotton waste	29,150,734	
Abaca		94,383,370
Henequen		57,315,493
Jute		45,612,850
Flax-hemp mixture		4,200,000
Hemp		2,362,000
Istle		1,365,139
Flax		375,978
Urena lobata		226,397
Silk		12,000
Total		433,855,932
Synthetic:		
Nylon		551,266
Rayon		281,446
Orlon		80,898
Total		913,610
Grand total		434,769,542

MAJOR END USES OF CORDAGE FIBERS

More than two-fifths of all fibers used by the cordage and twine industry in 1951 went into production of farm ropes and twines. Baler twine accounts for more than any other product. About a third is utilized in manufacture of industrial cordage and twine. Marine cordage and twine and household and other twines each take about 10 percent of the total poundage (table 2).

Table 2.-Major end uses of the cordage fibers consumed during 1951

Major end uses	Proportion of pounds consumed	
	Percent	
Farm rope and twine		42
Baler twine	26	
Binder twine	9	
Other farm rope and twine	7	
Industrial cordage and twine		34
Oil and gas well cable	2	
Other industrial cordage and twine	32	
Household and other twines		11
Marine cordage and twine		9
Fishing cordage and twine		2
Miscellaneous		2
Total	100	
Number of pounds	434,769,542	

The hard-fiber industry is the major user of cordage fibers; it used almost two-thirds of the total number of pounds utilized in manufacturing cordage and twine products in 1951. Of the total quantity of synthetic fibers used for this purpose, slightly more than half was used by cotton and other manufacturers and slightly less than half by the soft-fiber industry. Data as to the quantities of synthetic fibers used by the hard-fiber industry were not collected. It is believed that so far only small quantities of synthetic fibers have been used by this part of the industry and these mainly in experimental research (table 3).

Table 3.-Proportion of natural and synthetic fibers used by different segments of the cordage and twine industry

Segment of industry	All fibers consumed	Natural fibers consumed	Synthetic fibers consumed
	Percent	Percent	Percent
Hard fiber manufacturers ----	62	63	-
Soft fiber manufacturers ----	16	16	48
Cotton and other manufacturers------------	22	21	52
Total ---------------	100	100	100
Number of pounds -----------	434,769,542	433,855,932	913,610

The various segments of the industry differ markedly with respect to the major cordage and twine products that are manufactured. For example, more than half the total number of pounds of cordage fibers used by hard-fiber manufacturers goes into production of farm rope and twine, chiefly baler twine, and about a fourth is used to make industrial cordage and twine.

Among both soft-fiber and cotton manufacturers, however, more than half the total poundage consumed is utilized in production of industrial cordage and twine. More than two-fifths of the total quantity of cordage fibers used by soft-fiber manufacturers goes into household and other twines, although cotton manufacturers use roughly a fifth in farm ropes and twines and about the same proportion in household and other twines (table 4).

Table 4.-Comparison among various segments of cordage and twine industry with respect to allocation of fibers to major end products

Major end products	All fibers		
	Hard-fiber manufacturers	Soft-fiber manufacturers	Cotton and other manufacturers
	Percent	Percent	Percent
Farm rope and twine ---------	58	1	18
Industrial cordage and twine --------------------	23	54	57
Marine cordage --------------	13	2	3
Fishing cordage and twine----	3	-	-
Household and other twines---	-	43	22
Miscellaneous ---------------	3	-	-
Total -------- -----	100	100	100
Number of pounds -----------	272,594,108	68,301,111	75,899,706

Two major end uses account for large quantities of natural fibers consumed by the cordage and twine industry: More than two-fifths of all natural fibers used goes into farm ropes and twines and more than a third into industrial cordage and twine.

The pattern of use for synthetic fibers differs significantly. More than half of all synthetic fibers utilized by the industry is used in making industrial cordage and twine products while more than two-fifths goes into marine cordage (table 5).

Table 5.-Comparison between natural and synthetic fibers with respect to end-use allocation

Major end products	Natural fibers	Synthetic fibers
	Percent	Percent
Farm rope and twine	42	2
Industrial cordage and twine	34	52
Marine cordage	9	41
Fishing cordage and twine	2	-
Household and other twines	11	5
Miscellaneous	2	-
Total	100	100
Number of pounds	433,855,932	913,610

The main difference between patterns of use by soft-fiber and cotton manufacturers concerns farm ropes and twines and household and other twines. Both these segments of the industry use more than half of their total pounds of fibers in industrial cordage and twines. Among manufacturers in the soft-fiber industry, however, more than two-fifths of their total poundage goes into household and other twines while for cotton manufacturers this end use accounts for only little more than a fifth of their total poundage. An almost equal quantity is used by the latter group in production of farm rope and twines (table 6).

Table 6.--Comparison between soft-fiber and cotton manufacturers with respect to their allocation of natural fibers to major end products

Major end products	Proportion of natural fibers consumed by:	
	Soft-fiber manufacturers	Cotton manufacturers 1/
	Percent	Percent
Farm rope and twine	2	19
Industrial cordage and twine	54	57
Marine cordage	2	2
Fishing cordage and twine	-	-
Household and other twine	42	22
Miscellaneous	-	-
Total	100	100
Number of pounds	67,865,260	75,565,959

1/ Includes two manufacturers who use synthetics primarily.

There are also differences between manufacturers of soft fibers and of cotton with respect to their use of synthetic fibers. Among soft-fiber manufacturers about equal proportions of the total quantity of synthetic fibers are utilized in production of industrial cordage and twine and marine cordage.

Cotton manufacturers, however, use the largest proportion for industrial cordage and twine, slightly less than a third for marine cordage, and 10 percent for household and other twines (table 7).

Table 7.-Comparison between soft-fiber and cotton manufacturers with respect to their allocation of synthetic fibers to major end products

Major end products	Proportion of synthetic fibers consumed by:	
	Soft-fiber manufacturers	Cotton manufacturers 1/
	Percent	Percent
Farm rope and twine	4	-
Industrial cordage and twine	47	60
Marine cordage	49	30
Fishing cordage and twine	-	-
Household and other twines	-	10
Miscellaneous	-	-
Total	100	100
Number of pounds	435,851	477,759

1/ Includes two manufacturers who use synthetics primarily.

As the names of the different segments of the industry imply, there are basic differences in the fibers used. Among hard-fiber manufacturers more than two-fifths of the total poundage of cordage fibers used in 1951 is accounted for by sisalana; more than a third by abaca; and henequen represents a fifth.

Jute accounted for more than two-thirds of the total quantity of fibers used by soft-fiber manufacturers; lint cotton for about a fifth; and small quantities of miscellaneous natural fibers such as hemp, istle, and flax for 10 percent.

Manufacturers of cotton cordage and twine used cotton almost entirely. More than two-thirds was lint cotton and about 30 percent was cotton waste. They also used small quantities of jute, istle, flax, and hemp.

Synthetic fibers - nylon, rayon and orlon - made up 1 percent of all fibers used in 1951 by soft-fiber and cotton manufacturers (table 8).

Table 8.-Comparison among hard, soft, and cotton manufacturers with respect to major fibers used during 1951

Fibers	Hard-fiber manufacturers	Soft-fiber manufacturers	Cotton manufacturers
	Percent	Percent	Percent
Sisalana	44	1/	-
Abaca	34	-	-
Henequen	21	-	-
Jute	-	68	1/
Cotton	1/	21	99
Other natural fibers	1	10	1/
Synthetic fibers	-	1	1
Total	100	100	100
Number of pounds	272,584,108	68,301,111	93,884,323

1/ Less than 1 percent.

Sisalana, abaca, and henequen are all hard fibers, that is, they are leaf fibers, hard, and of coarse texture. Jute and cotton are bast fibers and are fine-textured and flexible. They are used in textiles as well as in cordage and twine. Hard and soft fibers differ basically as to characteristics, and individual fibers in both groups also differ markedly. It is natural, therefore, that different fibers are used to produce various kinds of cordage and twine products, so far as the end uses demand special characteristics.

It is not the purpose here to discuss the various measurable differences of all cordage fibers, rank them, and relate them to the end uses for which they seem best suited. The primary purpose of the study reported here was to find out from manufacturers the fibers they use in the different cordage products they manufacture and their reasons for using these particular fibers.

Manufacturers of cordage and twine have several problems which are of concern to all of them. However, there are problems of particular importance to each, especially with respect to the fibers used and the products manufactured. Therefore, it seemed more useful to group the opinion data which follows into opinions of hard-fiber, soft-fiber, and cotton manufacturers, respectively.

OPINIONS OF MANUFACTURERS IN THE HARD-FIBER INDUSTRY

Sisalana

Most of the sisalana used during 1951 in cordage and twine products was used by the hard-fiber industry, and all manufacturers of hard-fiber cordage reported its use. Major products made from sisalana by the hard-fiber industry were: Baler twine, industrial twines, and farm rope (table 9).

Table 9.-Proportion of hard-fiber manufacturers who used sisalana in various cordage products in 1951

Cordage products	Proportion of hard-fiber manufacturers
	Percent [1]
Baler twine	71
Industrial twines	59
Farm rope	41
Industrial cordage	29
Wire rope centers	29
Fishing cordage	23
Binder twine	18
Marine cordage	12
Fishing twines	6
Number of manufacturers	17

[1] Percentages add to more than 100 as some manufacturers made more than one cordage product from sisalana.

Hard-fiber manufacturers reported that three-fourths of all the sisalana they used went into baler twine, and that almost a fifth was used to produce industrial cordage and twines (table 10).

Table 10.-Proportion of sisalana reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion of sisalana used
	Percent
Baler twine	75
Industrial cordage and twine	18
Binder twine	5
Farm rope	1
Miscellaneous 1/	1
Total	100
Number of pounds	120,988,213

1/ Includes some marine cordage and twine, fishing cordage and twine, oil and gas well cable, and household and other twines.

Reasons for using sisalana in various cordage products.-Manufacturers who reported using sisalana were asked to specify which of their products were made from it and to tell why sisalana is particularly suited for these end uses. References to price and tensile strength were usually made first, regardless of the product. Other reasons show a relationship between the characteristics of the fiber and the particular end use. Replies are to the question: "Why is sisalana particularly suited for ----?"

Baler twine:	Number of manufacturers 1/
Strong; strong enough	7
Cheaper than abaca	7
High knot-break strength	5
Spins a more uniform yarn in small sizes	3
Knots don't slip	2
Stronger than henequen	1
Adequate strength within size tolerance	1
Good cut-break strength	1
Meets yardage standards	1
A uniform fiber	1
Lighter in color than henequen	1
Can be made in sizes to fit knotting-machine specifications	1
Weathering not an important factor	1
Works well on our machines	1
Spins well	1
Can be made insect resistant	1
Available	1
Number of manufacturers who replied	12

Industrial twines:	Number of manufacturers 1/
Cheaper than abaca	7
Strong; strong enough	5
Pliable, flexible, soft	4
High knot-break strength	3
Smoother than henequen	2
Knots don't slip	2
Easy to handle	2
Durability not important	2
Doesn't stain packages	2
Resistant to abrasion	2

Industrial twine: (continued)	Number of manufacturers [1]
Stronger than henequen	1
Stronger than jute	1
Good, hard feel	1
Spins level, as level as thread	1
Good elasticity	1
Satisfies bulk requirements	1
More resistant to abrasion than jute	1
Established consumer acceptance	1
Number of manufacturers who replied	10

Farm rope:	
Cheaper than abaca	7
Strong; strong enough	3
Pliable, flexible, soft	2
Easy to handle	2
Stronger than henequen	1
A better size for pulleys, other machine specifications	1
Good for limited uses	1
Available	1
Resistant to abrasion	1
Resistant to mildew	1
Resistant to water, moisture	1
Number of manufacturers who replied	7

Industrial cordage:	
Cheaper than abaca	4
Strong; strong enough	2
A better size for pulleys, other machine specifications	2
Stronger than henequen	1
Less elasticity than abaca	1
Can be soft laid	1
Resistant to abrasion	1
Resistant to dry abrasion	1
More resistant to abrasion than abaca	1
Satisfactory where durability is not important	1
Established consumer acceptance	1
Number of manufacturers who replied	5

Wire rope centers:	Number of manufacturers [1]
Cheaper than abaca	2
Pliable, flexible, soft	2
Spins level, as level as thread	2
Can be held to close tolerance	2
A uniform fiber	1
Very finely textured	1
Clean	1
Makes a good cushion for wire strands	1
Resistant to abrasion	1
Number of manufacturers who replied	5

Binder twine:	
Strong; strong enough	3
High knot-break strength	1
Spins a more uniform yarn in small sizes	1
Cheaper than abaca	1
Weathering is not an important factor	1
Works well on our machines	1
Number of manufacturers who replied	3

Fishing cordage and twines:	
Cheaper than abaca	1
Good for limited uses	1
Satisfactory where good durability is not required	1
As durable as abaca for lobster fishing	1
Number of manufacturers who replied	3

Marine cordage (thread-size tying ropes):	
Cheaper than abaca	2
Strong; strong enough	1
Durability not an important factor	1
Number of manufacturers who replied	2

---

[1] The frequencies add to more than the number of users because most manufacturers gave more than one reason for using sisalana in different cordage and twine products.

In manufacturers' own words, sisalana is used because:

> It is strong and soft for twine. Easy on the hands. Sisalana is much stronger than henequen. It's fine, spins level. It can be spun as level as a piece of thread. This takes fine fiber and soft.
>
> A particularly clean and uniform fiber which lends itself to producing a rope that can be held to close size tolerances. It has high resistance to abrasion when dry.
>
> Sisalana is best for baler twine. There are size limitations due to knotting mechanisms. You cannot use a cheaper fiber. To produce adequate strength within size tolerances you must use the stronger fiber (stronger than henequen).
>
> Knot strength is higher than in abaca. It is soft, pliable, and also stainless. It is used in tying bundles of papers in paper mills, also the circulation department of newspapers use it for bundling papers.
>
> It makes the best rope available at modest cost. It is reasonably pliable, easily handled, has good tensile strength and good moisture resistance.
>
> For wire rope centers sisalana seems to have some superior quality as a cushion for wire strands, and slightly greater flexibility, and therefore it's better than abaca. Also it's cheaper.

Opinions regarding undesirable characteristics of sisalana.--A major objective of the study was to find out in what ways fibers in current use might be improved to meet requirements of the manufacturers. Therefore, when the respondent had finished explaining his reasons for using sisalana in the products he made, he was asked to describe any characteristics of the fiber that he did not like. More than half of those who used sisalana said they had not found that the fiber had any undesirable characteristics. Among those manufacturers who had noted undesirable characteristics, the main ones were that sisalana is difficult to process, is not as strong as abaca, and the raw fiber reaches them without being thoroughly cleaned. The question was asked: "Does sisalana have any undesirable characteristics in manufacturing these particular products?" (Yes) (No) If yes, "What are the undesirable characteristics?"

Replies	Pct. 1/	Replies	Pct. 1/
Difficult to process	35	Not suited to hard-fiber machinery	6
Not as strong as abaca	18	Does not spin evenly	6
Not well cleaned	12	Not sufficiently dried	6
Lower strength when wet than abaca	6	Not well packed	6
Poor resistance to abrasion when wet	6	Poorly graded	6
Can be used only in third-grade lines	6	Sisalana has no undesirable characteristics	58
Difficult to obtain	6	Number of manufacturers who replied	17
Shorter fiber than abaca	6		

1/ Percentages add to more than 100 as some manufacturers mentioned more than one undesirable characteristic of sisalana.

A few comments from manufacturers who would like to see improvements made in sisalana follow:

> It has poor wet strength as compared to abaca; poor resistance to abrasion when wet.
>
> The only disadvantage is the shortness of the fiber as compared to abaca. If an agave is too short it makes for lack of uniformity.
>
> It's a little more difficult to treat than some other hard fibers.
>
> Brazilian sisalana has knots in it and too much dirt. It is not graded to uniform length. It is graded to color and that makes it very hard to handle because other sisal is graded to length and color does not enter into it.
>
> It doesn't have quite the strength of abaca.
>
> It does the job and price is the big consideration. If you could get abaca for the same price you wouldn't use it. It's neither as strong nor as water resistant.
>
> Snarl in the fiber. It leaves lumps in the yarn. It's much harder to spin Java Haitian but East African is nicely laid out. Mexican and second-grade Haitian cause the trouble. They're not packed as well.

Henequen

Of the manufacturers interviewed, 88 percent reported use of 57,315,493 pounds of henequen in the manufacture of cordage and twine during 1951. Major products made from henequen were: Industrial twines, farm ropes and twines, and binder twine.

The proportion of hard-fiber manufacturers who used henequen in various cordage products in 1951 is listed below:

Cordage products	Percentage of hard-fiber manufacturers [1/]
Industrial twines	60
Farm rope	40
Binder twine	33
Baler twine	20
Industrial cordage	13
Number of manufacturers	15

1/ Percentages add to more than 100 as most manufacturers made more than one product from henequen.

Binder twine, which was manufactured by a third of the companies, accounted for more than half the total pounds of henequen used by the industry. About a fourth was used in baler twine and a fifth in industrial cordage and twines.

The proportion of henequen reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of henequen used
Binder twine	54
Baler twine	24
Industrial cordage and twine	20
Farm rope	2
Total	100
Number of pounds	57,315,493

Reasons for using henequen in various cordage products.—The main reason for using henequen had to do with the price of the raw fiber. Manufacturers said it was cheaper than either abaca or sisalana, and was priced right for the consumers' acceptance price on the finished product. Replies are to the question: "Why is henequen particularly suited for ---?"

Industrial twines:	Number of manufacturers [1]
Cheaper than abaca, sisalana	7
Long life not an important factor	2
High knot-break strength	1
Strong enough in large sizes	1
Stronger than jute	1
Doesn't cut through wrappings	1
Resists abrasion	1
Sufficiently elastic	1
Number of manufacturers who replied	8

Farm rope:	Number of manufacturers [1]
Cheaper than abaca, sisalana	5
Strong enough	2
Good for limited uses	1
Resistant to dry rot	1
Adequate for the purpose	1
Sufficiently elastic	1
Number of manufacturers who replied	5

Binder twine:	Number of manufacturers [1]
Cheaper than abaca, sisalana	4
Strong enough	4
High knot-break strength	3
Priced right for consumers' acceptance price on finished product	1
Knots don't slip	1
Works well on our machines	1
Meets yardage standards	1
Can be made resistant to insects	1
Spins a more uniform yarn in small sizes	1
Number of manufacturers who replied	5

Baler twine:	Number of manufacturers [1]
Priced right for consumers' acceptance price on finished product	2
Strong enough	2
Works well on our machines	1
Established consumer acceptance	1
Number of manufacturers who replied	3

---

[1] The frequencies add to more than the number of users because most manufacturers gave more than one reason for using henequen in different cordage and twine products.

A few comments made by manufacturers as to why they use henequen follow:

> For halter rope it does not have to have too much flexibility, nor too much tensile strength. It does the job and is cheap. It is durable enough under weathering and is sufficient for the job.
>
> Henequen is cheaper and is therefore preferred (by the user) because of its cost.
>
> Henequen has sufficient tensile strength, dry rot resistance, and elasticity to be used in halter ropes.
>
> Henequen is used for commercial twine if the price spread is adequate. Commercial twine is an overhead cost to a firm and the cheapest they can get is what they want.
>
> Henequen is cheapest, and it still has satisfactory knot strength and tensile strength to be used for binder twine. It is available, and can be treated for insect resistance.
>
> It is cheap and does produce a satisfactory binder twine, if spun 500 feet to the pound.

Opinions regarding undesirable characteristics of henequen.-Manufacturers were asked to mention any complaints they had about henequen from their experience with the fiber. Only 2 in 10 who had used henequen felt that the fiber had any undesirable characteristics. The chief objection to henequen was that it reaches the manufacturer without being thoroughly cleaned. Replies are to the question: "Does henequen have any undesirable characteristics in manufacturing these particular products?"

Replies	Pct. [1]
Not well cleaned	20
Not as strong as abaca	13
Can be used only in third-grade lines	7
Difficult to get	7
Not sufficiently dried	7
Coarse; harsh	7
Less resistant to water than abaca	7
No complaints about henequen	80
Number of manufacturers who replied	15

---

[1] Percentages add to more than 100 as most manufacturers mentioned more than one undesirable characteristic of henequen.

Hard-fiber manufacturers reported using some istle and maguey, usually in mixtures with henequen. The mixtures were used to make industrial cordage and twine and farm ropes. Also, some maguey was reported used in the manufacture of wire-rope centers. The high cost of raw fibers like abaca and sisalana was the only reason given for using mixtures, but maguey was used in wire-rope centers because it is finely textured and will spin a fine level cord.

Sisalana was mixed with American hemp to produce fishing rope and twine. The reason given was that it is adequate for use during one season.

Comments of manufacturers regarding some undesirable characteristics in henequen are given here:

> Its tensile strength is less. It is coarser, harsher, and dirtier than sisal.
>
> The preparation of the fiber is not too good. It comes to us dirty. It is poorly decorticated - either too much pulp left in it, not sufficiently dried, or too green.
>
> It (henequen) is not as suitable as sisalana (for baler twine) but it is available when sisalana is not, and also it is cheaper.
>
> Henequen is not as smooth as sisalana.
>
> It's only good as an extender.

Fibers that have been used as substitutes for sisalana and henequen.- About half the manufacturers of industrial, farm, and marine cordage said they had used substitutes for sisalana. The fibers most often used as substitutes in industrial cordage and twines are istle and maguey, the latter also a member of the agave family. The istle reported here includes palma, pita, and zamandoque, but not the juamave or tula istle. American hemp and jute were usually substituted for sisalana in farm ropes and twines, and jute was reported as the only substitute for sisalana in marine cordage (table 11).

Table 11.-Fibers substituted for sisalana in major cordage products

Fibers which have been substituted for sisalana	Cordage products usually made from sisalana		
	Industrial	Farm	Marine
	Number [1]	Number [1]	Number [1]
Istle	4	1	--
Maguey	3	--	--
Jute	1	3	1
Sisalana tow	1	--	--
American hemp	--	4	--
Cotton	--	2	--
Henequen	--	1	--
Had used no substitutes	8	5	1
Number of manufacturers	14	11	2

[1] Frequencies add to more than the total number of cases because some manufacturers used more than one substitute in various cordage products.

Considerably more manufacturers have used substitutes for henequen than for sisalana, and istle and maguey are the fibers most often substituted in industrial cordage products. Cotton and jute, however, were the fibers most often used in place of henequen in farm ropes and twines (table 12).

Table 12.-Fibers substituted for henequen in major cordage products

Fibers which have been substituted for henequen	Cordage products usually made from henequen	
	Industrial	Farm
	Number [1]	Number [1]
Istle	3	--
Maguey	2	--
Jute	1	3
Sisalana tow	1	--
Cotton	--	5
American hemp	--	2
Had used no substitutes	1	3
Number of manufacturers	9	8

[1] Frequencies add to more than the total number of cases because some manufacturers used more than one substitute in various cordage products.

Manufacturers who had used substitutes for sisalana and henequen in their products were asked their opinions about them. In general, they found more disadvantages than advantages in using substitutes. The comments made about the different fibers are shown below, grouped into favorable and unfavorable opinions:

Jute

Favorable

The right length for our machines

Unfavorable

Tensile strength too low, too soft for our machines; tangles up; slows production, less resistant to abrasion than sisalana

Too dark

Not properly cleaned

Poor resistance to rot, mildew, water

Too high in price

Unfavorable

Too much stretch

Poor customer acceptance

Deteriorates under alternating wet-dry conditions

Ties a poor knot

Won't spin evenly

Requires too much bulk to attain required strength

American Hemp

Spins a uniform yarn

Tensile strength too low

Too soft for our machines

Tangles up; slows production

Too dark in color

Won't work on customer's machines

Cotton

Favorable	Unfavorable	Unfavorable
Strong enough for some end uses	Tensile strength too low	Too high in price
Fair knot-break strength	Too soft for our machines	Too much stretch
	Tangles up; slows production	

Maguey

Too soft for our machines	Too dark in color
Tangles up; slows production	Low knot-break strength
Low tensile strength	Cuts the hands
	Does not spin evenly

Abaca

Available sources of abaca.--Before World War II all abaca used in the United States was imported from the Philippines. Today, however, our manufacturers can get abaca from Central America, where plantations were cultivated and subsidized during the war. Most manufacturers, therefore, get their supplies from both sources, but a few use only Philippine abaca. None of the manufacturers said they were not able to get adequate supplies. Among those who used Central American abaca, however, some criticisms were elicited by the question: "In what ways do you think the Central American abaca could be improved?"

Replies	Number 1/
Machine-cleaning methods need to be improved	3
A chemical extractor should be developed to replace water in cleaning	3
Has less sheen than Philippine abaca	3
Fiber is too long	3
Over-dry, brittle, dusty, harsh	3
Machine cleaning decreases sheen	2
Grading is not uniform	2
Not as strong as Philippine abaca	2
Has less resistance than Philippine abaca because it has more pulp	2
Tows up more than Philippine abaca, particularly in fine yarns	1
Artificial drying is not as good	1
Doesn't have as good a color as Philippine abaca	1
Too pulpy	1
Fibers are tangled, cemented together	1
Only comes in two grades	1
Deteriorates rapidly because it is brittle	1
Less resistant to abrasion	1
Appearance not as good as Philippine abaca	1
No complaints about Central American abaca	1
Number of manufacturers who replied	14

1/ Frequencies add to more than the total number of users because most manufacturers had more than one criticism of Central American abaca.

Some comments about Central American abaca:

> Central American abaca has better color but does not make such a good appearing rope as Manila. In fact what we do use is only used as a component part of the rope, for color value only. We do not know of any way in which it might be improved as we feel we have no complaint for the price we pay. Of course, it is not hand cleaned like Manila but it is coming through much cleaner than when we first started getting it during the war.
>
> To tell you the truth, I think they have made great strides toward improvement. During the war we had to use it for almost all our products; at that time it was not adequately cleaned which it now is; it got tangled easily and was hard to work with. It is a good product now. The moisture content was not good at one time, but it is all right now.
>
> It's all right the way it is. The only thing the boys notice here is, it has a tendency to comb out dusty at times. I like the color, the good texture, boldness of the fiber, and its good strength. The fiber is graded on color and the finished rope has a color requirement; converted it is a color value noted as "becker value". ...Philippine abaca has a cobwebby appearance but Central American is free from that. Central American is all right except for dustiness.

About 8 in 10 hard-fiber companies manufactured marine cordage, industrial rope, and farm ropes from abaca; more than 7 in 10 were making fishing rope, and more than half oil and gas well cable; almost 3 in 10 fishing twines, and about a fourth industrial twines.

The proportion of hard-fiber manufacturers who used abaca in various cordage products is listed below:

Cordage products	Percentage of hard-fiber manufacturers[1]
Marine cordage	82
Industrial ropes	82
Farm ropes	77
Fishing ropes	71
Oil and gas well cable	53
Fishing twines	29
Industrial twines	24
Number of manufacturers	17

1/ Percentages add to more than 100 as most manufacturers made more than one cordage product from abaca.

Hard-fiber manufacturers used 94,383,370 pounds of abaca during 1951 in the products listed. Production of marine and industrial cordage absorbed close to two-thirds of the total poundage.

The proportion of abaca reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of abaca used
Marine cordage	37
Industrial cordage and twine	25
Farm ropes	11
Fishing cordage and twines	7
Oil and gas well cable	7
Baler twine	4
Miscellaneous [1]	9
Total	100
Number of pounds	94,383,370

---

[1] Includes 7 percent used in Government orders in which the type of cordage product is not identified.

Reasons for using abaca in various cordage products.—Manufacturers were asked their opinions as to why abaca is particularly suited for certain end uses. Its high tensile strength and durability were the two qualities most often mentioned. Replies are to the question: "Why is abaca particularly suited for ----?"

Marine cordage:	Number of manufacturers [1]
High tensile strength	7
Resistance to salt water	6
Does not absorb water; does not swell in water	4
Deteriorates less than any other natural fiber	4
Stronger than sisal, henequen, jute	4
High weight-strength ratio	3
Does not stiffen in water; easy to handle when wet	3
Greater resistance to salt water than either sisalana or henequen	3
Flexible	2
Good elasticity	2
Cheaper than nylon	2
Excellent wet strength	1
Few slivers	1
Better lubricated	1
Resists rot, weather	1
Greater resistance to weather than either sisalana, henequen, or nylon	1

Marine cordage (continued):	Number of manufacturers [1]
Excellent resistance to abrasion	1
It stretches before it breaks	1
Smooth handling; ease of handling	1
Economical	1
Long-established usage; customer acceptance	1
Number of manufacturers who replied	14

Industrial cordage:	
High tensile strength	12
High weight-strength ratio	5
Excellent resistance to abrasion	5
Smooth handling; ease of handling	5
Great durability	5
Flexible	4
Safer because stronger	3
Good resistance to weather	3
Good elasticity	3

Industrial cordage (continued):	Number of manufacturers 1/
Less deterioration than other natural fibers	2
Stretches before it breaks	2
Does not conduct electricity	2
Long-established usage; customer acceptance	2
Excellent wet strength	1
Few slivers	1
Resistance to rot, water, moisture, dry rot	1
More durable than other hard fibers	1
More durable than jute	1
Not oiled, therefore does not stain	1
Can be made into a soft-laid rope	1
Cheaper than nylon	1
Economical	1
Number of manufacturers who replied	14

Oil and gas well cable:	
High tensile strength	6
Resistant to abrasion	6
Good elasticity	3
High weight-strength ratio	2
Resistant to strain	2
Resistant to shock	2
Smooth handling; ease of handling	2
Can be made into a hard-laid cable	2
Excellent wet strength	1
Safer because stronger	1
Good insurance against loss of expensive riggings	1
Flexible	1
Smooth, few slivers	1
Resistant to weather, water, oil	1
Great durability	1
Economical for a cable	1
First-grade abaca rope is guaranteed by manufacturer	1
First-grade abaca rope is required by insurance companies	1
Number of manufacturers who replied	9

Farm rope:	Number of manufacturers 1/
High tensile strength	10
Resistant to weather	6
High weight-strength ratio	5
Resistant to abrasion	3
Smooth handling; ease of handling	3
Safer because stronger	2
Flexible	2
Resistant to water, moisture, dry rot	2
Excellent wet strength	1
High knot strength	1
Smooth; few slivers	1
Hand cleaned	1
Round fiber, therefore less breakage	1
Good elasticity	1
Resistance to rot	1
Better lubricated	1
Durable	1
Economical	1
Number of manufacturers who replied	12

Fishing rope:	
High tensile strength	9
Resistant to water	9
Resistant to weather	4
High weight-strength ratio	2
Excellent wet strength	2
Does not absorb water	2
Does not stiffen in water; easy to handle when wet	2
Deteriorates less than other natural fibers	2
Cheaper than nylon	2
Long established usage; customer acceptance	2
Stronger than sisalana	1
Greater strength, therefore less danger of losing a catch	1
More flexible	1
Smooth, few splinters	1
Better lubricated	1
Round fiber absorbs treatment better	1
More durable than nylon	1
Resistant to abrasion	1

Fishing rope (continued):	Number of manufacturers 1/
Treatment with copper increases resistance to rot, mildew, water	1
Lubrication increases durability	1

Fishing rope (continued):	Number of manufacturers 1/
Smooth handling; ease of handling	1
Great durability	1
More economical	1
Number of manufacturers who replied	12

Here are some of the comments made by manufacturers who use abaca in marine cordage products:

> It's the strongest natural fiber (except China grass which we can't get) for rope making.
>
> It's better; it resists water and is strong. It doesn't deteriorate in water to any great extent and is much stronger. It's been used for a hundred years and nothing has ever taken its place.
>
> Superior tensile strength - superior utility. It does not swell as much as sisalana, therefore it stiffens up less than any other fiber. Furthermore, it deteriorates less than any other fiber.

A few comments of manufacturers who use abaca in the manufacture of industrial cordage:

> Safety is a big factor. Abaca's tensile strength and its lasting quality, less deterioration. Its resistance to dry rot and moisture makes it superior to other cordage fibers. Manila rope is more pliable, more flexible in going around small corners. Abaca is smoother and softer on the hands; no harsh fibers to get in the hands like a sliver. It's more resistant to abrasion due to its texture.
>
> Customers demand it. It has a lot of good qualities. Mostly feel, handling. If you couldn't see it or feel it you wouldn't care what you bought. It has good wearing qualities. Personally I like to handle jute rope but it doesn't last long enough.

Some comments on the use of abaca in fishing rope:

> I don't think it makes any difference as long as the ropes are treated with copper compounds. Certainly has been our experience with sales anyway. During the war fishermen bought buoy lines of treated sisal and found it just as good as Manila. Better. Lasts longer....
>
> For certain work sisal is just as good and cheaper--as for lobster pots. It gets such hard wear and sisal is cheaper and both sisal and abaca have to be treated with copper and neither wears long--so sisal wears just about as long as Manila.

Opinions regarding undesirable characteristics of abaca.-Most manufacturers said that abaca has some undesirable qualities from the standpoint of its use in the cordage products they make. Most complaints, however, have to do with methods of cleaning and grading the fiber, both in Central America and the Philippines. The question was asked: "We've talked about why abaca is suited for manufacturing the different products you use it for. Does the fiber have any undesirable characteristics in manufacturing these particular products?"

Replies	No.[1]
Needs a more uniform grading system	6
Tows up in machines	6
Knots have not been removed, add to the weight	5
Neither properly cleaned nor inspected	4
Length of fibers not uniform	4
Fibers are tangled up	3
Fibers are too long	2
Tow ends are not removed	1
Would like it to be softer, yet retain its other characteristics	1
Strength is not uniform	1
Grading is down 1 or 2 grades	1
Contains weak, brittle fibers	1
Too expensive	1
No complaints about abaca	3
Number of manufacturers who replied	17

---

[1] Frequencies add to more than the total number of users because most manufacturers mentioned more than one undesirable characteristic.

Here are some comments made by manufacturers regarding the undesirable characteristics of abaca:

> Sometimes if fibers are not up to grade it gives trouble. They throw a few knots in the bales; that throws the machines off. There has been a decided drop in the Philippine inspection service.
>
> The fiber itself is all right; it is in the processing of it. It needs better grading and better cleaning and they should leave the knots out of the bales. Knots in the bales slow production. Since the war the grading is down one or two grades. It was very poor but it is getting better. The knots have been worse since the war and they amount to considerable weight at times. Hand cleaning is much better than machine cleaning because there is less pulp. We can blend the several grades from the Philippines and therefore it is more advantageous from a merchandising standpoint, than the two or three grades we get from Central America.
>
> The only bad thing is when they don't clean it and cut the tow ends off. I mean the tops where the fiber begins to thin out.
>
> Abaca does cause tow bunches. The little fine fibers at the tip end break off and bunch up. Occasionally it will cause a breakdown of the machinery in the spinning process. Then occasionally, because of careless cleaning and baling, abaca fiber has knots which cause breakdowns.

Abaca is harder on the machinery because of its greater length, therefore it is subject to cutting to usable size before processing and puts a greater pull on the machinery than other hard fibers.

There is one. It is hard to explain. There is a characteristic of the fiber bundles which produce entangled fiber bunches and entangled fibers, producing undesirable slugs or knots. Also it is not the most desirable thing to receive fiber longer than 72 inches. You have to cut it. The length of the spinning machine is determined by the length of the fiber.

I would like to have it softer and still keep its other characteristics. We think if this could be done still further uses could be found for it.

The undesirable characteristics of any natural fiber; the strength and size of fiber varies from one year to the next depending on the growing conditions.

Fibers that have been used as substitutes for abaca.--Manufacturers were asked whether they had ever used substitutes for abaca in any of their products. All had used substitute fibers at one time or another, mainly during World War II when abaca was scarce. However, substitutions occurred most often in cordage manufactured for marine, industrial, and farm uses, and less often in cordage made for fishing and oil and gas well work.

Sisalana had been used in place of abaca by all manufacturers; jute had been substituted for abaca in particular end uses by almost 7 in 10 and American hemp by close to 4 in 10. Henequen, paper, and mixtures were the only other substitutions reported (table 13).

Table 13.--Fibers substituted for abaca in major cordage products

Fibers which have been substituted for abaca	Cordage products usually made from abaca					
	All uses	Marine cordage	Industrial cordage and twine	Farm ropes and twines	Fishing cordage and twine	Oil and gas well cable
	Percent 1/	Percent 1/	Percent 1/	Percent 1/	Percent 1/	Percent 1/
Sisalana	100	79	79	61	42	44
Jute	69	29	50	38	--	--
American hemp	37	43	21	8	--	--
Henequen	29	29	21	23	--	--
Mixtures 2/	29	--	--	23	--	--
Paper	6	--	7	--	--	--
Had used no substitutes	--	7	7	23	58	56
Number of manufacturers	17	14	14	13	12	9

1/ Percentages add to more than 100 as some manufacturers had used more than one fiber as a substitute for abaca in different products.

2/ American hemp with either jute or sisalana.

Opinions of hard-fiber manufacturers regarding sisalana as a substitute for abaca.-Manufacturers were asked to explain on the basis of their own experience with sisalana how well it had worked as a substitute for abaca in the different products they made. In general, there were more unfavorable than favorable opinions, but they were largely related to the particular end use. Interviewers asked: "In what ways was sisalana satisfactory? In what ways was sisalana not satisfactory?" Satisfactions and dissatisfactions are shown separately for major products.

Eleven manufacturers of marine cordage replied:

Favorable	No.
Works well on our machines	2
Good for limited marine uses	2
Fairly strong	1
Flexible	1
Resistant to dry abrasion	1
Ties well	1
Good for ropes up to half an inch	1
Don't know	1

Unfavorable	No.
Not as strong as abaca	9
Has poor resistance to water	7
Cumbersome; difficult to handle	3
Low weight-strength ratio	2
Low wet strength	2
Swells in water	2
Stiffens in water	1
Not flexible enough	1
Rough, splintery	1
Poor resistance to abrasion	1
Poor durability	1
Poor elasticity	1
Great flexual fatigue	1
Fiber too short for our machines	1
Not satisfactory in any way	1

Eleven manufacturers of industrial ropes and twines replied:

Favorable	No.
Good for limited industrial uses	5
Works well on our machines	3
Strong enough in larger sizes	2
Resistant to dry abrasion	1
Fiber is shorter than abaca	1
Entirely satisfactory	1

Unfavorable	No.
Not as strong as abaca	9
Poor durability	6
Cumbersome; difficult to handle	5
Low weight-strength ratio	2
Poor resistance to abrasion	2
Poor elasticity	2
Poor resistance to water	1
Stiffens in water	1
Rough, splintery	1
Poor resistance to weather	1
Not as good as abaca	1
Not satisfactory in any way	1

Eight manufacturers of farm ropes replied:

Favorable	No.
Good for limited farm uses	5
Cheaper than abaca	3
Strong enough in larger sizes	2
Works well on our machines	1

Unfavorable	No.
Poor durability	7
Not as strong as abaca	6
Cumbersome; difficult to handle	4
Rough, splintery	2

Favorable	No.	Unfavorable	No.
Fairly strong	1	Poor elasticity	2
Flexible	1	Poor resistance to weather	2
Resistant to dry abrasion	1	Stiffens in water	1
Resistant to rot	1	Poor resistance to abrasion	1
Resistant to weather	1	Low break strength	1
		Not satisfactory in any way	2

Five manufacturers of fishing ropes replied:

Favorable	No.	Unfavorable	No.
Adequate where great durability not important	2	Not as strong as abaca	5
Satisfactory if treated with copper compounds	2	Poor resistance to water	3
Good for limited fishing uses	1	Cumbersome; difficult to handle	2
Cheaper than abaca	1	Poor durability	2
		Poor resistance to weather	2

Four manufacturers of oil and gas well cable replied:

Favorable	No.	Unfavorable	No.
Fairly strong	2	Poor durability	2
Durable enough	1	Not as strong as abaca	1
Works well on our machines	1	Poor resistance to water	1
		Low weight-strength ratio	1
		Poor resistance to abrasion	1
		Poor resistance to weather	1
		Not satisfactory in any way	1

Opinions regarding other substitutes for abaca in industrial, marine, and farm cordage.-Attitudes of manufacturers generally toward the use of jute, American hemp, henequen, and paper as substitutes for abaca was that they could be used if nothing else were available, but that they would not use them to replace abaca if either abaca or sisalana were available. Seven respondents had used jute as a substitute for abaca in industrial ropes and twines, five in farm ropes, and four in marine cordage. They said of jute with respect to -

Industrial ropes and twines

	No.		No.
Not as strong as abaca	4	Not as strong as sisalana	1
Poor durability	4	Poor resistance to weather	1
Poor resistance to abrasion	3	Poor elasticity	1
Low weight-strength ratio	2	Cumbersome; difficult to handle	1

Farm ropes

	No.		No.
Not as strong as abaca	4	Poor elasticity	1
Poor durability	4	Cumbersome; difficult to handle	1
Poor resistance to weather	1		

Marine cordage

	No.		No.
Not as strong as abaca	4	Poor elasticity	1
Poor resistance to water	2	Too expensive	1
Poor durability	2	Not adaptable to our machines	1

Six manufacturers had used American hemp in place of abaca in marine cordage, three in industrial ropes and twines, and one in farm ropes. They described American hemp with respect to its use in -

Marine cordage

	No.		No.
Not as strong as abaca	4	Poor elasticity	1
Too soft, tears in machines	3	Too expensive	1
Poor resistance to water	2	Low break strength	1
Poor durability	2	Cumbersome; difficult to handle	1
Poor cleaning causes production difficulties	2	Lack of uniformity causes difficulties in processing	1

Industrial ropes and twines

	No.		No.
Not as strong as abaca	2	Cumbersome; difficult to handle	1
Poor durability	2	Difficult to process	1
Soft, tears in machines	2	Too dirty and dusty	1
Low weight-strength ratio	1		

Farm ropes

	No.		No.
Not as strong as abaca	1	Poor resistance to weather	1
Poor durability	1		

Among manufacturers of marine cordage four had used henequen as a substitute for abaca, and three had substituted it in industrial ropes and twines and farm ropes. With respect to its use in these major products, they said:

Marine cordage

	No.		No.
Not as strong as abaca	3	Not adaptable to our machines	1
Poor resistance to water	2	Low weight-strength ratio	1
Cumbersome; difficult to handle	2	Low wet strength	1
Poor durability	1	Swells in water	1
Poor elasticity	1	Not flexible	1

Industrial ropes and twines

	No.		No.
Not as strong as abaca	2	Poor resistance to abrasion	1
Poor durability	2	Poor elasticity	1
Low weight-strength ratio	1	Cumbersome; difficult to handle	1

Farm ropes

	No.		No.
Poor durability	3	Poor elasticity	1
Not as strong as abaca	2	Cumbersome; difficult to handle	1
Poor resistance to weather	1		

Paper had been substituted for abaca by one manufacturer in industrial rope and twine. He said paper was unsatisfactory because it is not strong enough.

Three had used mixtures of American hemp with either jute or sisalana in place of abaca in their farm ropes. They all indicated dissatisfaction with the substitutes, saying, "The durability was poor - poor resistance to both weather and water, and they were not as strong as abaca."

Fibers which manufacturers would most like to see developed as substitutes for abaca and sisalana.-No fiber was selected by a large majority of the manufacturers as a possible substitute for abaca, but about a third said they would like to see improvements made in sisalana so it might be a more satisfactory substitute. About 3 manufacturers in 10 named nylon and miscellaneous fibers such as Dacron, Saran, rayon, sansiveria and henequen. About 3 in 10 said they did not think there was any fiber that could replace abaca or that they didn't know of any that could.

Fibers which hard-fiber manufacturers would like to see developed as substitutes for abaca are listed below:

Fibers	Percentage of hard-fiber manufacturers[1/]
Sisalana	35
Nylon	29
Orlon	18
Fiberglas	12
Synthetic fibers generally	6
Miscellaneous fibers	29
Don't know, or none	29
Number of manufacturers	17

[1/] Percentages add to more than 100 since some manufacturers named more than one fiber they would like to see developed as a substitute for abaca.

Reasons given by manufacturers for selecting particular fibers they would like to see developed as substitutes for abaca.–The six who specified sisalana as the fiber they would most like to see improved for use as a substitute for abaca said it was because sisalana:

	No.		No.
Can be run on our machines	5	Has fair durability	2
Is fairly strong; is strongest fiber next to abaca	4	Resists dry rot	1
Is good for limited uses	3	Is available in the Western hemisphere	1
Is cheaper than abaca	2	Most closely resembles abaca	1

The four manufacturers who selected nylon said nylon:

Is available in the domestic market	3	Is stronger than abaca	1
Has high elasticity	2	Would improve our product	1

Reasons given by the three manufacturers who chose orlon were that orlon:

Is available in the domestic market	2	Is less elastic than other synthetics	1
Does not deteriorate in oil and grease	1		

The two manufacturers who specified fiberglas said it was because fiberglas:

Is available in the domestic market	2	Does not deteriorate in sunlight	1
Is economical enough to compete with hard fibers	2	Resists rot	1
		Is stronger than abaca	1

About two-thirds of the manufacturers expressed no interest in seeing any particular fiber developed for use in place of sisalana. Among those who specified fibers, the largest proportion named miscellaneous natural fibers such as sansiveria, ramie, kenaf, jute, and American hemp. Interest was shown in miscellaneous synthetic fibers -- nylon, orlon, rayon -- by about 2 in 10. About 1 in 10 mentioned fiberglas.

Fibers which hard-fiber manufacturers would like to see developed as substitutes for sisalana are listed below:

Fibers	Percentage of hard-fiber manufacturers[1]
Miscellaneous natural fibers	29
Miscellaneous synthetic fibers	18
Fiberglas	12
Don't know, none, no answer	65
Number of manufacturers	17

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[1] Percentages add to more than 100 since some manufacturers showed interest in more than one fiber as a substitute for sisalana.

Opinions of hard-fiber manufacturers toward the use of sansiveria in cordage and twine products.-Regardless of whether or not a manufacturer had ever used sansiveria, he was asked to give his opinions about its use in his own products. About 6 in 10 had an unfavorable attitude toward the use of sansiveria in their own products. The two major objections were that sansiveria is not as strong as abaca and is too expensive. The responses are grouped below under favorable and unfavorable opinions:

Favorable	No.	Unfavorable	No.
Probably could be developed as a substitute	4	Not strong enough; not as strong as abaca	6
Tensile strength is fairly good	1	Too expensive	5
A fine textured fiber	1	Poor resistance to water	3
Spins well on our machines	1	Doesn't make as good a product as abaca	3
The Navy found it satisfactory	1	Towing interferes with production	2
		Smaller in diameter than abaca	2
		Requires special treatments	2
		Difficult to get	2
		Machines require special equipment in order to spin it	2
		Should not be salt-retted	2
		Our experiments with it were not successful	2
		Not interested in a cheap rope	2

Some reactions of hard-fiber manufacturers regarding the use of sansiveria in their own products follow:

> I don't know anything about it except it is scarce and expensive.
>
> We're perfectly happy to stay with abaca. We advertise that we only make one grade of rope, first-grade. We're not interested in cheaper ropes. That is our whole principle of rope making.
>
> As a substitute it's the best of the lot. It's all a question of price. It isn't salt-retted. Might be interested if it is salt free. It has to be treated.
>
> We try to make it of abaca because we think it is better. Everything is predicated on experience and we believe there's nothing like Philippine or Central American abaca.
>
> We haven't used it. It's between a soft and hard fiber and requires special equipment to run it. It hasn't the strength of abaca. It probably could be developed as a substitute.
>
> A possible substitute. It is spinnable, it has fair tensile strength and it gives promise if developed. I don't know much more about it.
>
> Its one claim to fame is that it is a very fine-textured fiber. Its strength is not good.

> It would seem to be a good fiber with the proviso that the fiber diameter is so much smaller than that of Manila. We never ran it. I only know that the Navy was interested and found it satisfactory.
>
> We know very little about it. We understand it has very good properties of water resistance and that you can make a good piece of rope out of it but we only know that by hearsay and not from experience.
>
> I don't think it is a substitute in any way. It doesn't work over machines as well. It has alleged water properties that sisal hasn't got. It tows (knots) up on the machine. I don't see any use for it. It couldn't possibly substitute for abaca. It isn't as good. Strength isn't as good, inherently not as good. We made some experiments with it but they were not successful because the machines towed it up.

Miscellaneous fibers used by the hard-fiber industry.-A few hard fiber manufacturers said they used coir, hemp, and flax in their cordage products. Coir was reported used in marine cordage, and the four manufacturers who used it said it was particularly suitable for the following reasons:

	Number		Number
Buoyant; floats with tide ----	3	Doesn't deteriorate in water --	1
Good stretch and recovery ----	2	Good for limited uses where excessive wearing is not a factor -------------------	1
Resists abrasion ------------	1		

Hemp was used in the production of small marine ropes and for binding off heavy ropes from hard fibers. The three manufacturers who reported its use said they liked it because hemp:

	Number		Number
Can be tarred successfully ---	2	Is supple, soft, smooth -------	1
Has been used traditionally --	2	Takes a sizing well ----------	1
Is the strongest of the soft fibers ------------------	1		

Opinions of hard-fiber manufacturers toward greater utilization of cotton in their industry.-In 1951 the hard-fiber industry used a negligible quantity of cotton as markers in industrial ropes and cords. Nevertheless, these manufacturers were asked whether they thought cotton could be utilized in more ways than it is used now in the manufacture of hard-fiber products. Ninety-four percent replied "No" to this question and six percent said they did not know. The former group was then asked their reasons for this opinion. The major reasons given were that cotton is not suited for running over hard-fiber machinery and is not strong enough for most hard-cordage uses. The responses are given below:

Cotton:	Percent 1/
Is not adaptable for running over hard-fiber machinery; the process is wasteful --	31
Is not strong enough for most hard-cordage uses ------------	31

Cotton (continued):	Percent [1]
Is too soft, it tears up in the machine	19
Does not wear well, last long	13
Absorbs too much water	13
Does not possess any of the characteristics of hard fibers	13
Stretches too much	6
Is too expensive; too high in price	6
Is more expensive than hard fibers	6
Is too soft for marine uses	6
Requires carding	6
Is suitable only as an extender in case of shortages	6
Does not even make a suitable extender	6
Is a short-staple fiber	6
Not ascertained	3
Number of manufacturers who replied	17

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[1] Percentages add to more than 100 because some manufacturers gave more than one reason for their opinion.

Synthetics

Nylon

About 4 in 10 hard-fiber manufacturers use or have used nylon in their cordage products; about 2 in 10 have used, or experimented with, orlon; and one manufacturer reported the use of rayon and Saran.

Among those who had used nylon, one manufacturer said he had used it only experimentally and had not yet formed any opinions as to its possible use. The others reported its use in a variety of marine and industrial products. These were:

Marine: Tow ropes, mooring lines, dock lines, yacht rigging.

Industrial: Tow ropes, airplane towing, whaling foregoers, heading twine for lobster pots.

Manufacturers were asked to explain the ways in which they found nylon particularly suited for their products. The following reasons were given:

	Number
High elasticity, resiliency	4
High tensile strength	3
Does not suffer marine damage	3
Not absorbent; does not have to be dried	2
Durable; long-wearing	1
Resists rot, mildew	1
Resists abrasion	1
More strength with less weight	1
Can be run in fine sizes	1
Makes a more uniform product	1
Number of manufacturers who replied	7

Manufacturers had two major objections to nylon: it is too expensive; and its great elasticity is a disadvantage for many purposes.

In the manufacturers' own words:

> For any purpose where resiliency is desired it is superior. It has a certain amount of elasticity but snaps back into place. This is desirable in things like tow ropes which otherwise might snap. It is used extensively for various things on yachts where cost is not a factor.
>
> We're not interested in it particularly. It's not much good, it stretches 30 percent. I don't hink it will ever get a foothold - except for specific jobs. Nylon rope is used to pick up gliders. There is not the jerk because of the stretch. It is now used for parachutes. It is extremely strong and can be spun very fine. Silk isn't half as strong. Nylon deteriorates in the sun though.
>
> We could make nylon rope tomorrow but the price is too high. It's 10 times as strong as abaca. The life of a rope depends on the care it gets and nylon won't wear 10 times as long as abaca. Nylon has twice the strength, however, but has disadvantages of elasticity - at least in most cases the elasticity is a disadvantage.
>
> Impervious to marine attack and mildew rot. It's used in heading twines for lobster-pot warps. Their long life is important because there is a lot of labor involved in changing these lines.
>
> For some ropes it is particularly suitable as, for example, in deep-sea towing line. Its extra elasticity makes it stand the shock of surges. Similarly, in a whaling line or foregoer it has the same shock ability so that when a whale is harpooned and it takes off, the line takes the stretch. Nylon rope is also good for airplane towing. It has the elasticity that enables it to tighten up on a load. But for most rope uses its elasticity is a particular disadvantage. Its usefulness as heading twine for lobster pots is its resistance to water damage.

Orlon

Manufacturers who reported the use of orlon said they still experiment with it in their products. The only uses specified were tent lines and guy wires, but most refused to disclose their experimental use of this fiber. Respondents stressed the fact that their opinions are only tentative as they have not yet seen the final results of their experiments. Some of the comments volunteered were:

> Orlon opens up new fields where nylon is not resistant to the elements, but it does not have the strength of nylon or Dacron. Orlon is not affected by the sun, which is one of its best points.
>
> We have done a little, a very little, experimentally with orlon recently, but our results at present are so vague we would not care to make any comments. I might say that so far we are not impressed.
>
> It has no advantage over nylon except that it does not fade or lose strength under light conditions.

Those manufacturers who used rayon and Saran reported the same use for both - in specialty twines. The reasons given for liking these fibers were:

Rayon	makes a uniform twine doesn't stretch
Saran	makes a uniform twine is waterproof

However, the same objection was expressed about each of these fibers - the price for the raw fiber is too high.

Factors Considered in Selecting Fibers for Hard-Fiber Industry

During the interviews hard-fiber manufacturers were asked to discuss all the fibers they use, any substitutes that were used during World War II, and those fibers with which they may have only experimented. They were asked to discuss the characteristics of these fibers in detail - both as to advantageous and disadvantageous characteristics from the viewpoint of use in their own products. So much detail made it difficult to evaluate the relative importance to the manufacturers of the different fiber characteristics they had discussed. Therefore, at the end of the interview, they were asked to consider, in a general way, what particular fiber characteristics they thought important to consider in choosing a fiber.

The results show that more than half mentioned tensile strength and almost as many referred to the adaptability of the fiber to their machinery. About two in five said they would consider the price and more than a third stressed durability (table 14).

Table 14.-Replies to the question: "Suppose that your company should decide to use some natural or synthetic fiber in place of some fiber that you are now using. What different factors do you think would be considered in selecting such a fiber?"

Replies	Proportion of hard fiber manufacturers	
	Percent [1]	
Tensile strength		53
Must have high tensile strength	47	
Must have high knot strength	12	
Must have maximum strength in minimum size	6	
Must have high wet strength	6	
Adaptable to our machines		47
Price		41
Would consider price (not further specified)	29	
Would consider price as compared to abaca	6	
Would consider stability of price	6	
Durability		35
Must have abrasion resistance	23	
Must have resistance to mildew, fungus	18	
Must have resistance to weather	12	
Must be impervious to oils, acids, greases, insects, rodents	6	
Must have resistance to rot	6	
Must have resistance to heat	6	
Must have water resistance	6	
Characteristics of fiber		29
Absorption qualities, capable of being treated	29	
Length of fiber	18	
Color of fiber	18	
Uniformity of fiber	12	
Flexibility; pliability	6	
Natural moisture content	6	
Suitability of product		23
Degree of efficiency	12	
Appearance of product	6	
Performance of finished product	6	
Availability		23
Degree of elasticity		23
Cost of conversion to new fiber		6
Consumer acceptance of new fiber		6
Similarity to abaca		6
Consideration of method of packing of new fiber		6
Not ascertained		12
Number of manufacturers	17	

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[1] Percentages add to more than 100 as some manufacturers mentioned more than 1 factor that would be considered in selecting a fiber.

Special Problems of the Hard-Fiber Industry [2/]

Availability of Fibers

Hard-fiber manufacturers were asked whether they have any trouble now (in 1952) in getting the fibers they want so far as the quality and quantity they want are concerned. One in four responded that they did have such problems. When those who said they had problems in getting fibers were asked to indicate which fibers they had trouble with -- 2 answered Philippine abaca, 2 answered sisalana, and 2 answered henequen.

Manufacturers were asked to describe their difficulties in getting these three fibers. The responses were:

Philippine abaca

Can't get the grades or marks we want; requires different mixing.

After a price drop, no Philippine abaca is on the market; feel it is withdrawn to prevent further decline and keep a firm market.

Sisalana

Mexican government refuses to fill its contract; says their country needs it.

Too small a supply of Javan or Sumatrian sisalana.

Henequen

Mexican government refuses to fill its contract; says their country needs it.

Mexican henequen sold at a price so low in Mexico that finished products can be sold in this country for less than we can buy the fiber.

Problems About Which Hard-Fiber Manufacturers Expressed Most Concern

Although the study reported here was limited in its objectives to the explanation and estimation of problems concerning the characteristics of fibers, certain other problems are so acute for this segment of the industry that they came up spontaneously throughout the interviewing. Therefore, they are reported here. The problems are mainly economic in nature and are interrelated, but for purposes of simplification they are reported separately in table 15.

A review of the data in table 15 shows that hard-fiber manufacturers are chiefly concerned with foreign competition and the general trend toward fewer uses for cordage and twine.

2/ In reporting the opinions and recommendations of manufacturers throughout this report, the Bureau of Agricultural Economics does not intend in any way to imply either agreement or disagreement with those opinions and recommendations. It reports them solely because a knowledge of the opinions of the manufacturers themselves may be of value to those who are interested in the cordage industry, and in the raw materials which it uses.

Table 15.-Problems about which hard-fiber manufacturers expressed most concern

Problems	Proportion of hard-fiber manufacturers	
	Percent [1]	
Foreign competition		88
Foreign manufacturers can sell finished cordage and twine products in this country at lower prices than can American manufacturers	82	
Government policies which have had an unfavorable effect on the industry	12	
Existing tariffs consider only differential labor costs and do not include office expenses	6	
General trend toward fewer uses for cordage and twine		65
Marine cordage being displaced by wire cable	18	
Heavy wrapping twines being displaced by wire and steel banding machines	18	
Consumer more interested in price than quality	18	
Modern ships require less rope than did the old sailing vessels	12	
Wire cable being substituted for oil-well cordage	12	
Combines have made binder twine unnecessary	12	
Technological changes have decreased uses for cordage and twine	12	
Light wrapping twines being displaced by adhesive tapes	6	
Adequate substitutes are cheaper	6	
Conflicting pressures on the industry		47
Government wants industry to work at full capacity during war but doesn't help it in peacetime; expects industry to be available when needed	41	
Foreign farm twines can be sold more cheaply and are capturing domestic market, but in wartime farmers may lose their source of supply	6	
Trend toward free world trade and the need of the industry for high protective tariffs	6	
Domestic competition		41
Increasing competition from synthetic producers	24	
Intense competition among companies works to the disadvantage of the industry	18	
Prison mills have taken over part of domestic market	6	

(Continued on next page)

Table 15.-Problems about which hard-fiber manufacturers expressed most concern -- (continued)

Problems	Proportion of hard-fiber manufacturers	
	Percent [1]	
Other problems		47
Industry dependent on overseas supplies of fiber	12	
Advertising and promotion cannot help the industry	12	
Industry needs to explore and develop new uses for cordage and twine	12	
Industry dependent on overseas sources for its machinery	6	
The high prices of raw fibers	6	
Part of domestic market lost in World War II when industry operated under controls	6	
General inflationary trend increases warehouse and shipping costs	6	
Number of manufacturers who replied	17	

[1] Percentages (left column) add to more than their subtotals (right column) and these total to more than 100 because most manufacturers mentioned more than one problem for the industry.

Manufacturers who discussed the general problems of their industry followed up, in most cases, with some suggestions as to what might be done to solve some of them. Their recommendations are reported in table 16.

Table 16.-Some suggestions of hard-fiber manufacturers with regard to solving the problems of the industry

Suggestions	Proportion of hard-fiber manufacturers
	Percent [1]
Increase existing tariffs; set up tariffs on cordage and twine products where none now exist; figure tariffs to equalize differential between our labor and operating costs and the subsidies of foreign governments to their cordage and twine manufacturers so that foreign products will compete with ours on a quality basis	88
The industry should work on developing new uses for cordage and twine to replace its lost markets	18
Our government should set quotas on foreign finished products	12

(Continued on next page)

Table 16.-Some suggestions of hard-fiber manufacturers with regard to solving the problems of the industry -- (Continued)

Suggestions	Proportion of hard-fiber manufacturers
	Percent [1]
Our government should control overseas competition--how not specified	6
People who understand the problems of the industry as well as the aims of government policy should work out the detailed solution to problems of the industry	6
We need to publicize our problems; educate those concerned with making policies that affect the industry	6
Our government might negotiate more with foreign governments as to the growing of cordage fibers	6
Control competition from prison mills	6
Encourage foreign governments to increase acreage planted to cordage and twine fibers	6
Industry will have to change over to the manufacture of products other than cordage and twine	6
Industry should maintain a progressive attitude toward improving its products	6
Controls should be removed so that the law of supply and demand can operate	6
Don't know	6
Number of manufacturers who replied	17

[1] Percentages add to more than 100 as most manufacturers made more than one suggestion with regard to solving the problems of the industry.

Expressions Regarding the Major Problems that Face the Industry

The major problem is foreign competition - lower wages in foreign countries compared to our wage standard. In many cases, the finished product can be bought from foreign countries cheaper than we can buy the fiber from that country.

First, I would say that the use of the rope has been reduced materially, especially baler twine, oil-well cordage, transmission rope. They're all through. Just reduced use. Take a ship today - 35 years ago they only had Manila and today they have wire rope. More use out of wire. When they consider price and length of service they switch to wire. Transmission rope is out. They run those machines by small motors. We even do that ourselves. Farmers don't use rope any more to pull hay into hayloft, they leave the hay in the fields. Competition from Mexico. They undersell us by 25 percent.

Our major problem is to remain in business and in a sound condition for the benefit of employees and stockholders and also the community at large, remembering that in case of war, the country would inevitably bog down without rope. It should also be remembered that under war conditions, the armed forces use a large quantity of rope to maintain their operations.

Foreign competition. Substitutes of synthetics for hard fiber and the new processes that are being invented to do away with rope and the like.

I think its losing out whether because of material handling, wire rope, synthetics, or import troubles, I don't know. And I see no possibility of any new development except adoption by our present industry of some new type of manufacturing. By that I mean an entirely new product - not connected with rope or twine. I think if some relief isn't obtained on imports from the standpoint of war, there'll be no industry to manufacture rope for war, and no industry to use the stockpile for this purpose. This may be strong, but that's the way I feel about it. Only new use we've found has been baler twine and the first thing done was imports taken off that and anyone with twine in their backyard could send it here and Mexicans sent in much. They have lower labor costs and grow their own fibers. They sell the raw fiber to their own manufacturers at a lower price than they do to us.

Under present conditions lack of sufficient volume to keep present facilities adequately busy. Offshore competition, which aggravates to a large extent. Prison competition, which does the same. Because of the above, intense competition between domestic companies as well as between domestic and offshore companies, keeps the cost of production - selling price relationship - too close for healthy maintenance of a sound industry.

Loss of market to foreign trade, more than substitution by synthetics. If tariff barriers are let down, for instance, and foreign products flood the country at a lower price, it would render all our machinery inactive and eventually obsolete. Whereas, in facing the field of synthetics things would work out more gradually. The government is stockpiling strategic materials for our industry in the interests of National Defense, but of what use will the materials be if our machinery is inactive and our plants rendered obsolete in the face of imported finished products. There would be no way to process these materials and essential ropes and other items of cordage could not be produced at a time when vitally needed.

Manufacturers' Own Words Regarding Outlook for the Industry

There is a declining use for the products in relation to the population. In the United States particularly, the hard fiber and cordage and twine industry is seriously threatened with loss of markets because of foreign competition with lower labor costs, of lower fiber costs through foreign government subsidy or both and inadequate tariff protection by the United States.

I think it is an absolute necessity to Government and to our people, and so far as I can visualize I don't believe anything will take its place in the economy of the country unless the State Department wants to shut us off like they did in Mexico. The Mexican Government subsidizes its sisal manufacturing 3 to 4 cents a pound and it should be debarred from entry into this country. The State Department reduced the tariff from 40 to 15 percent and they're selling the end product cheaper than they will sell to us. Our sisal mills are practically shut down so Mexico can run full and their government gives them 3 to 4 cents subsidy to do it. I think our future is all right provided they (government) don't perform like that again. Another thing tariff doesn't consider is the difference in office expense, only figure labor. Our nonproduction is just as high (wages) as production. In working out tariffs they only consider labor costs in figuring. Our office workers are paid on a par with the labor but they don't take that into consideration.

The country has a tremendous stockpile (of cordage fibers) and the only way it can be disposed of is to have a cordage industry that can use it. If the present importation of foreign-made cordage continues at its present level with every indication that it will increase, I don't see much hope for the domestic industry.

The consumption requirements of this country will continue about at their present rate, the future of the domestic industry will depend on how much of that market would be available to them. We do face ever-increasing import competition, but the product we are making ranks highest in the world.

This industry, with a possible exception of agricultural twines, is not an expanding industry. In peacetime there is not sufficient volume to keep present facilities busy. As it is a vital industry necessary for national defense, adequate facilities for expanded wartime production must be maintained. We are confident that a method will be worked out to do this and that the industry, therefore, will remain at about its present size.

I think there'll always be a use for twine and cordage but not necessarily Manila or sisal. In other words, I'm a firm believer that synthetics will be developed that will do the job better. I think the industry will get smaller and if we don't get some relief on imports we'll go out of business as an industry. At the present time I doubt very much if I'd put my son in the business.

Decreasing uses for rope, together with foreign and domestic competition make us view the future with dubiety.

Synthetic fibers are taking the place of hard-fiber ropes to a certain extent. Wire cables have taken the place of rope cables in marine uses. Wire and steel bands and adhesives have replaced to a large extent and are further replacing wrapping twines. The use of binder twine is declining rapidly because of continued expansion in use of combines. It is possible that synthetic fibers may eventually replace hard fibers in baler and binder twines. The use of baler twine is increasing and may eventually replace the loss in use of binder twines.

It is not an expansive industry and the best that can be hoped for it is that usage will maintain a per capita poundage related to the population. Our industry is a fair target for all the snythetic producers but above all it is an absolute target for the offshore manufacturers of hard-fiber products who have lower labor and overhead costs and can always compete with us in the domestic market. This is particularly so because most countries in the world today, in one way or another, subsidize their manufactured products and against competition of this nature we are in great difficulty to maintain a sound industry. It has to be remembered that all of our fibers are imported and that the machinery we use is for the most part manufactured in Europe. Accordingly, we have no intrinsic advantage that can maintain us in being. That is about enough. Oh! - One exception to this is the existence of the small remaining tariff protection. In time of war our industry would be required to produce 3 to 4 times the quantity of rope that we can expect to produce during peacetime. The capacity of the industry is, in fact, related to the wartime requirements of rope. And this capacity should be maintained in the interest of national security. If, however, we are to lose our peacetime business to foreign competition, our potential to produce for wartime necessities will inevitably be reduced to the detriment of the national security.

OPINIONS OF MANUFACTURERS IN THE SOFT-FIBER INDUSTRY

Jute

About two-thirds of the companies in the soft-fiber industry said they used jute in the manufacture of cordage products. They estimated that 45,476,850 pounds of the fiber were consumed in this end use during 1951. All those who used jute said they made industrial twines from it, almost two-thirds produced farm cordage, and more than a third made industrial ropes of various types (table 17).

Table 17.-Proportion of soft-fiber manufacturers who used jute in various cordage products in 1951

Cordage products	Proportion of soft-fiber manufacturers	
	Percent 1/	
Industrial twines		100
Wrapping and tying twines	72	
Twines for tying sand bags	9	
Roving twines	9	
Twines for tying springs	9	
Cotton baling twines	9	
Meat twines	9	
Farm ropes and twines		63
Industrial ropes		36
Box handles	18	
Ropes for textile machines	9	
Lariats	9	
Industrial cords - welting		18
Marine cordage		18
Number of manufacturers	11	

1/ Percentages add to more than 100 as some manufacturers made more than 1 cordage product from jute.

Of all jute used in cordage products about three-fourths went into industrial end uses during 1951 and a fifth into household twines.

The proportion of jute reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of jute used
Industrial cordage and twine	76
Household twines	21
Farm ropes and twines	3
Marine cordage	1/
Total	100
Number of pounds	45,476,850

1/ Less than 1 percent.

Reasons for using jute in various cordage products.-Soft-fiber manufacturers gave a variety of reasons for using jute, most of which were directly related to end uses. Comments about price: It is cheap, cheaper, cheaper than cotton or hemp were mentioned in connection with all cordage products. Replies are to the question: "Why is jute particularly suited for ----?"

Wrapping twines:	Number [1]
Price: cheap, cheaper than cotton, hemp ----------	6
Strong; strong enough for requirements -----------	3
Ties easily; ties a better knot ------------------	3
Knots don't slip ---------	2
High knot-break strength--	1
Stronger than cotton -----	1
Soft, flexible, pliable --	1
Not too elastic ----------	1
Resistant to water -------	1
Long-wearing, durable ----	1
Habit; customarily used --	1
Number of manufacturers who replied ------------	8

Farm ropes and cables:	
Doesn't cut hands, vines, vegetables ------------	5
Price cheap -------------	4
Not too elastic ----------	2
Weather resistant --------	2
Strong; strong enough for requirements ----------	1
High knot-break strength -	1
Flexible, pliable --------	1
Good appearance ----------	1
Smooth ------------------	1
Can be run in fine numbers	1
As plant grows, twine rots away -------------	1
Number of manufacturers who replied -----------	7

Welting cords:	
Price cheap --------------	2
Strong enough for requirements ------------	1
Soft --------------------	1
Not too elastic ----------	1
Good appearance ----------	1
Smooth ------------------	1
Long-wearing, durable ----	1
Spins more easily --------	1
Number of manufacturers who replied -----------	2

Box handles:	Number [1]
Doesn't cut hands ----------	2
Price cheaper than hemp ----	1
Strong; strong enough for requirements ------------	1
Not too elastic ------------	1
Can be made resistant to mildew, rot -------------	1
Number of manufacturers who replied ----------------	2

Marine cordage:	
Price cheap, cheaper than cotton, hemp ------------	2
Strong; strong enough for requirements ------------	1
Soft, flexible, pliable ----	1
Number of manufacturers who replied ----------------	2

Twines for springs, cotton bales, meats:	
Price cheaper than cotton --	1
Strong; strong enough for requirements ------------	1
Soft, flexible, pliable ----	1
Not too elastic ------------	1
Good appearance ------------	1
Doesn't cut hands, meats ---	1
Durable, long-wearing ------	1
Number of manufacturers who replied ----------------	1

Sandbag twines:	
Price cheaper than cotton --	1
Stronger than cotton -------	1
Great resiliency -----------	1
Durable, long-wearing ------	1
Can be made resistant to mildew, rot -------------	1
Number of manufacturers who replied ----------------	1

Rove twines:	
Price cheaper than cotton --	1
Stronger than cotton -------	1
Knots don't slip -----------	1
Number of manufacturers who replied ----------------	1

Lariats:	Number 1/
Price cheap ------------	1
Soft, flexible, pliable	1
Dries quickly ----------	1
Weather resistant ------	1
Number of manufacturers who replied ----------	1

Ropes for textile machines	Number 1/
Price cheap ------------	1
Number of manufacturers who replied ----------	1

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using jute.

Opinions regarding undesirable characteristics of jute.-Only 23 percent of the soft-fiber manufacturers questioned had any complaints about jute with respect to their own use of it in particular cordage products. These were:

	Number
Not well cleaned ----------	2
Doesn't blend well with cotton ------------------	1
Requires an oil treatment, but this makes it less acceptable to consumers ---	1
Fiber is too short --------	1
Fiber is not uniform in diameter ---------------	1

	Number
Some employees develop allergies to it ----------	1
Cannot control the quality -	1
Grading is poor ------------	1
No complaints about jute ---	8
Number of manufacturers who replied -----------------	11

Fibers that have been used as substitutes for jute.-Istle is the fiber most often reported used as a substitute for jute. A few manufacturers said they had substituted cotton, kenaf, and sisalana on occasion (table 18).

Table 18.-Fibers substituted for jute in major cordage products

Fibers which have been substituted for jute	Cordage products usually made from jute			
	All uses	Industrial cordage and twine	Farm ropes and twines	Marine cordage
	Number 1/	Number 1/	Number 1/	Number 1/
Istle -------------------	6	6	2	1
Cotton ------------------	2	1	-	-
Kenaf -------------------	1	-	1	-
Sisalana ----------------	1	-	-	-
Never used a substitute for jute ---------------	4	4	4	1
Number of manufacturers ----	11	11	7	2

1/ Frequencies add to more than the total number of cases as some manufacturers used more than 1 substitute in various cordage products.

Opinions regarding fibers used as substitutes for jute.- In general, manufacturers were fairly well satisfied with the fibers they have used in place of jute in industrial cordage products. The comments about each fiber are shown here grouped by whether or not they were favorable.

The six manufacturers who had used istle said:

Favorable	Number	Unfavorable	Number
Cheaper than jute	3	Requires treatment to make soft	4
Easy to process	3	Cuts the hands	1
Not too elastic	3	No domestic supply	1
Fairly strong	2	Not pliable	1
High knot-break strength	2	Poor appearance	1
Better supply	2	Not satisfactory in any way	1
Soft, flexible, pliable	1		
Durable	1		
Superior yardage per pound	1		

The manufacturer who had used cotton said it requires dyeing and is not as strong as jute, but it's smooth, doesn't cut hands, and is strong enough for the requirements.

The one who had used kenaf said it is not as strong as jute, but it's generally satisfactory and available in the home market.

In the case of sisalana the manufacturer reported it to be durable, of light color, can be hard-laid, and stays clean longer than jute.

Both istle and kenaf were reported used as substitutes for jute in farm ropes and twine, and manufacturers appear to have been fairly well satisfied with them.

The two manufacturers who had used istle said:

Favorable	Number	Unfavorable	Number
Adequate strength	2	Too coarse, cuts hands and plants	2
Easy to process	1	Poor appearance	1
Cheaper than jute	1		
Not too elastic	1		
Yardage per pound equals jute	1		

The one who had used kenaf said it has a low-break strength, but is generally satisfactory and would be available in the domestic market.

Fibers which manufacturers would most like to see developed as substitutes for jute.-About 3 in 10 soft-fiber manufacturers who used jute in the manufacture of cordage and twine products expressed interest in kenaf as a substitute for jute in this end use. Slightly more than 1 in 10 favored the development of cotton. About 3 in 10 said either that they did not know or that they had no interest in substitutes for jute.

Fibers which soft-fiber manufacturers would like to see developed as substitutes for jute are listed below:

Fibers	Percentage of soft-fiber manufacturers
Kenaf	29
Cotton	14
Henequen	7
Nylon	7
Orlon	7
Fiberglas	7
Don't know; none	29
Total	100
Number of manufacturers	14

Reasons given by manufacturers for selecting particular fibers they would like to see developed as substitutes for jute.-The major reasons given by soft-fiber manufacturers for preferring kenaf as a substitute for jute was that it can be made available here and that it can be extracted mechanically. Those who chose cotton referred to it as an "ideal, all-purpose fiber." Replies to the question: "What are your reasons for this choice of fiber?"

Kenaf	Number [1]
Can be made available in home market	2
Can be extracted mechanically	2
Uniform in diameter	1
Cheap	1
Its use requires no change in machinery	1
Can be used in some products for which jute is now used	1
It is as strong as jute	1
Number of manufacturers who preferred	4

Cotton	Number [1]
An ideal, all-purpose fiber	2
Always available in home market	1
Can be spun in both coarse and fine numbers	1
Blends with synthetics and improves them	1
Number of manufacturers who preferred	2

Henequen	Number [1]
Cheaper than jute	1
More uniform in diameter than jute	1
Number of manufacturers who preferred	1

Miscellaneous fibers (nylon, orlon, fiberglas)	Number [1]
There would be a stable source of supply at stable prices	2
It would be more profitable in the long run	1
Number of manufacturers who preferred	3

---

[1] Frequencies add to more than their totals as most manufacturers gave more than 1 reason for preferring a particular fiber.

Kenaf

Opinions of soft-fiber manufacturers regarding the outlook for kenaf in their industry.-Kenaf was the fiber which the largest proportion of soft-fiber manufacturers would like to see developed as a substitute for jute. However, all soft-fiber manufacturers, regardless of whether they had spontaneously referred to kenaf, were asked their opinions concerning the further utilization of kenaf by the industry. More than a third said they did not know or lacked enough experience with it to have formed an opinion. Among those who had opinions nearly all expressed both favorable and unfavorable ones. The main favorable responses were that kenaf would make a good substitute for jute and that kenaf would provide a domestic source of supply. The major criticisms were that kenaf is not as strong as high-grade jute, that it's rough and harsh, and presents a cleaning and decorticating problem which needs to be solved before it will be completely adaptable as a substitute for jute (table 19).

Table 19.-Replies to the question: "What do you think about kenaf as a possible fiber to use in the products you manufacture?"

Replies	Proportion of soft-fiber manufacturers	
	Percent 1/	
Favorable		65
Would be a good substitute for jute	45	
Would provide a source of raw-fiber supply in this country	24	
Would be a good substitute for hemp, if properly cleaned	18	
Would be a good substitute for hemp, if available at same price	18	
Better than jute because it resists mildew	6	
Satisfactory if water-retted	6	
Could be used if tensile strength and resistance to abrasion were improved	6	
Cleaner than jute	6	
Unfavorable		53
Not as strong as high-grade jute	44	
Government should tackle the problem of cleaning and decorticating kenaf	24	
Its too rough, harsh, hairy	24	
Not adaptable to our products	24	
It has poor color	12	
Quality equals that of lower grades of jute	12	
Lacks spinning qualities of high-grade jute	12	
If water-retted, lacks resistance to mildew	12	
Should be water-retted to remove all sap	12	
Don't know, no experience with it		35
Number of cases	17	

1/ Percentages add to more than their subtotals and these add to more than 100 because most manufacturers made more than one comment about kenaf.

Some of the Comments Made by Soft-Fiber Manufacturers About Kenaf

It has most of the characteristics of jute but it's in its experimental stage. It is only the second year it has been grown for these purposes. Because of the unrest in Pakistan and the closeness of commitments we are trying to get kenaf grown to meet any event that might happen. Kenaf is a government-subsidized product grown in Florida, Alabama, and Louisiana. It is satisfactory in every way except perhaps in tensile strength. But we've only had one year's experience with it, and expect it will be improved as to strength and that it will be as good as jute.

Kenaf, particularly if water-retted, can be used in many of our products, but strength will be lower than jute and the yarn harsher and more hairy. Kenaf apparently does not split down in carding as well as jute, flax, or hemp. Accordingly, the coarser yarns that do not require as fine a split are made more successfully from kenaf than from fine yarns. The harshness of kenaf may be less of a detriment in coarse yarns and twine than in fine yarns.

I think it has good possibilities provided they'll clean it but they will never make a good fiber out of it until they ret it. All bast fibers have sap in them. They can scrape all they want and there is some left. It dries and crystalizes and is left there like glass. When you tie it, it cuts itself. That is not true with retted fibers; water washes it all out. It's a perfectly good fiber if properly done. It will never compete with jute on price. It isn't any better than jute so it has got to compete with the price of jute. It will do anything jute will do if retted right. The Government should stop spending money on growing it and get to the job of retting and cleaning it right. As I said, it is a good fiber but not any better than jute.

Decordicated kenaf is superior to jute in that mildew will not attack it which is not true of jute. Retted kenaf will develop mildew; you must make a distinction between them. Kenaf is processed when retted by soaking in water about 8 days and micro-organisms attack it and eat away the outside leaving the fiber. But the micro-organisms remain and any time the finished product gets in a warm, damp atmosphere, it mildews. Kenaf artifically cleaned does not have the micro-organisms and so does not mildew.

Kenaf in its present stage of development is no better than ordinary first (lower) grades of jute from Pakistan or India. Most of what we have had seems to have been harvested too late. This makes it brittle. Up to this stage it could only replace the lowest grades of jute. First of all it is a dirty slate-color. It doesn't have the strength of jute, and because of lack of strength it doesn't have the spinning qualities of high-grade jute. I think they are a little overenthusiastic at this point. There's a lot of development to do on it. I'm not opposing the program; I think the idea and the purpose is good. The idea of getting a local source of supply. But I am afraid the cost of producing the fiber in this country will be beyond that in foreign countries unless the job can be done by highly mechanized means. Then again for general acceptance of the fiber to replace Indian or Pakistan jute the quality must approach the "tossa" grades from those countries. Kenaf appears to be a white fiber, which is of itself not objectionable but at the moment the "tossa" or reddish brown color of Indian and Pakistan jutes is more desirable in this country. We have also used the Nigerian kenaf but found that it, too, has somewhat similar characteristics.

Would be a wonderful substitute if the decortication is perfected. It is not as strong as jute on the present method of decortication. That may be breaking down the particles or structure of the fibers. It is a substitute in all ways. It is very close to a Mesta fiber which is very good. I'd say it is that fiber and we are giving it another name.

Cotton

Next to jute, cotton is used in greatest quantity by the soft-fiber industry in the manufacture of cordage and twine products; more than a third of the soft-fiber companies reported using 13,838,857 pounds of lint cotton during 1951. This represents close to a fifth of the total quantity of cotton reported used in the cordage industry for this period, and nearly all of it went into the manufacture of household twines. A very small quantity was used in production of fishing twine.

The proportion of soft-fiber manufacturers who used cotton in various cordage products in 1951 is listed below:

Cordage products	Percentage of soft-fiber manufacturers 1/
Household twines	67
Fishing twines	83
Number of manufacturers	6

1/ Percentages add to more than 100 as some manufacturers made more than 1 product from cotton.

The proportion of cotton reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of cotton used
Household twines	96
Fishing twines	4
Total	100
Number of pounds	13,838,857

Reasons for using cotton in household wrapping and fishing twines.-Among manufacturers who reported the consumption of cotton in cordage products, one used a blend of lint cotton with cotton waste and the other three used cotton yarn. These respondents were asked their reasons for using cotton in these products. Specific responses were related to both the type of cotton consumed and the type of product made. Replies are to the question: "Why is cotton yarn particularly suited for-----?"

Household twines:	Number [1]
Has good tensile strength	1
Easy to tie	1
Ties a good knot	1
Smooth, not rough or splintery, doesn't cut	1
Number of manufacturers who replied	2

Fishing twines:	Number [1]
Cheaper than nylon	1
Cheaper than flax	1
Cheaper than silk	1
The cheapest fiber that can be used	2
Number of manufacturers who replied	3

---

[1] Frequencies add to more than their totals as most manufacturers gave more than 1 reason.

Replies are to the question: "Why is a blend of lint cotton and cotton waste particularly suited for-----?"

Household twines:	Number
It is cheap enough to make twine expendable	1
Number of manufacturers who replied	1

Fishing twines:	Number [1]
Can be given a special treatment to prevent deterioration	1
Can be tarred	1
Cheaper than flax	1
Number of manufacturers who replied	1

---

[1] Frequencies add to more than their totals as this manufacturer gave more than 1 reason.

Fibers that have been used as substitutes for cotton.-Soft-fiber manufacturers who reported that they ordinarily used cotton in certain of their products were also asked whether they had ever used substitutes for cotton in their products and, if so which of the fibers they had used in place of cotton. Responses show that rayon has been used by the largest proportion of manufacturers as a substitute for cotton. Fibers substituted for cotton in major cordage products are listed below:

Fibers which have been substituted for cotton	Percentage of soft-fiber manufacturers [1]
Rayon	35
Nylon	12
Vinyl plastic, plastics	12
Jute	6
Fiberglas	6
Had never used any substitutes for cotton	47
Number of manufacturers	17

---

[1] Percentages add to more than 100 as some manufacturers had used more than 1 fiber as a substitute for cotton.

Opinions regarding fibers used as substitutes for cotton.-Soft-fiber manufacturers who had used any fibers in place of cotton in their products were asked their opinions regarding how well these fibers had worked as compared with cotton. Manufacturers expressed both favorable and unfavorable opinions about each but, in general, their experience can be summed up as unsatisfactory. Respondents were classified into favorable and unfavorable and are shown separately for each fiber:

Rayon

Favorable	No.	Unfavorable	No.
Higher tensile strength than cotton	2	Lower knot-break strength	4
More attractive, decorative	2	Too slippery	4
Superior yardage per pound	1	Less resistance to water	3
Cheaper than cotton	1	Too soft, flattens out	2
Price more stable	1	Nothing satisfactory about it	2
Adequate strength	1	Not as strong as cotton	1
Entirely satisfactory	1	Strength decreases when wet	1
		Cuts the hands	1
		Less resistant to abrasion	1
		Will not run smoothly over pulleys	1
		High amount of absorption	1
		Doesn't dye well	1
		Too elastic	1
		Less yardage per pound	1

Nylon

Good tensile strength	1	Too expensive	1
Good elasticity	1		

Vinyl plastic, plastic

		Too much stretch	1
		Difficult to clean	1
		Wire center wore through	1
		Not at all satisfactory	1

Fiberglas

Adequate strength	1	Less resistant to abrasion than cotton	1
Not too much stretch	1	Does not run smoothly over pulleys	1
Cheaper than nylon	1		

Jute

Cheaper than cotton	1	Less profit in it than cotton	1

Opinions regarding further utilization of cotton.-Soft-fiber manufacturers who ordinarily use cotton and those who do not were asked their opinions as to greater utilization of cotton in their industry. Seven in 10 said they felt cotton was utilized as much as it could be by the industry at the present time. About 2 in 10 said they did not know, and about 1 in 10 thought there were areas in which cotton might be utilized to a greater extent than it is now.

Replies to the question: "Do you think that cotton could be utilized in more ways than it now is in the manufacture of soft-fiber products?", are listed below:

Replies	Percentage of soft-fiber manufacturers
Yes	12
No	70
Don't know	18
Total	100
Number of manufacturers	17

The two manufacturers who said they thought cotton could be more fully utilized were asked to specify the areas in which cotton could be used more extensively than it now is. One said he thought cotton could be used in making lustrous and more decorative ribbons, and the other referred to an end use which was not classified under cordage and twine--the manufacture of rugs. The manufacturer who suggested greater utilization of cotton for decorative ribbons pointed out that cotton takes dye well and can be specially treated to give it a lustrous sheen.

Most soft-fiber manufacturers did not think cotton could be more fully utilized by the industry than it is now. These respondents were asked to discuss further the reasons for their thinking. The main reasons they gave were that cotton is one of the oldest fibers and must have been experimented with in all possible ways, and that the new synthetics coming in are superior to cotton. Question: "Why do you think that cotton could not be utilized in more ways than it now is in the manufacture of soft-fiber (cordage) products?"

Replies from 12 soft-fiber respondents were:	Percent [1]
Cotton is one of the oldest known fibers; its uses must have been fully explored	25
Synthetics are coming in and they are superior	25
Cotton is limited by being a short-staple fiber	17
Other fibers are cheaper than cotton	17
Cotton is limited in tensile strength	8
Cotton is not a superior product for our uses	8
Cotton has an advantage now because our present machinery is not adaptable to other fibers	8
Treatments to make cotton mildew-proof have not yet been perfected	8
Don't know	25

---

[1] Percentages add to more than 100 as some manufacturers gave more than 1 reason for their opinion.

Hemp and Flax

About half the soft-fiber companies reported the use of hemp and more than a third the use of flax in the manufacture of cordage and twine products. These fibers are usually blended together, and 4,200,000 pounds of this mixture were used in 1951. In addition, 2,116,000 pounds of hemp and 360,378 pounds of flax were used during the same period. The mixture of hemp blended with flax was used entirely for household twines and more than a third of all hemp used went into this product, while the remaining hemp and flax individually were used in a variety of marine and household cordage products (table 20).

Table 20.-Proportion of soft-fiber manufacturers who used hemp, flax, and a mixture of hemp and flax in various cordage products in 1951

Cordage products	Proportion of soft-fiber manufacturers who used:					
	Hemp		Flax		Hemp-flax mixture	
	Percent 1/		Percent 1/		Percent 1/	
Marine		100		—		84
Cordage and twine		75		—		—
Marlines	75		—		—	
Fishing twines	—		—		84	
Rope		50		—		—
Ratlines	50		—		—	
Houselines	13		—		—	
Shot lines	13		—		—	
Hambrolines	13		—		—	
Industrial		75		—		100
Twines		63		100		100
Tying springs	50		—		17	
Upholstery	13		—		17	
Tying meats	13		—		—	
Jacquard looms	—		—		50	
Money-bag seals	—		—		17	
Gas-meter diaphragms	—		—		17	
Scientific and measuring instruments	—		—		17	
Household twines	38		100		—	
Rope		25		—		—
Wire-rope centers	13		—		—	
Tying hides	13		—		—	
Number of manufacturers	8		1		6	

1/ Percentages add to more than 100 as most manufacturers made more than 1 cordage product from each of the fibers.

In terms of poundage allocation about 6 in 10 pounds of hemp consumed by the soft-fiber industry went into industrial cordage products and more than a third went into household twines. But 7 in 10 pounds of flax were used in the manufacture of marine cordage and twine and the remainder in industrial products (table 21).

Table 21.-Proportion of hemp, flax, and hemp-flax mixtures reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion used		
	Hemp	Flax	Hemp-flax mixture
	Percent	Percent	Percent
Industrial cordage and twine	62	30	--
Household twines 1/	35	--	100
Marine cordage and twine	3	70	--
Total	100	100	100
Number of pounds	2,116,000	360,378	4,200,000

1/ Household twines can be classified under industrial twines, but as this end use accounts for such a large proportion of the total, it has been reported separately.

Reasons for using hemp in various cordage products.-Soft-fiber manufacturers gave a variety of reasons for using hemp in different cordage products, most of which were directly related to the use of the fiber in a specific product. References to tensile strength and durability were made in discussing the use of the fiber for most of the products. The specific reasons given are shown separately for each product together with the frequency with which each were mentioned, as follows:

Six who made marlines of hemp said hemp is:

	Number		Number
Soft, flexible, pliable	3	Has good tensile strength	1
Resists salt water	2	Ties a hard firm knot	1
Is not too elastic	2	Resists weather	1
Required by Government specifications	2	Resists abrasion	1
Has high knot-break strength	1	Is more available in the home market	1
Is stronger than jute	1	Resists rot	1

Reasons given by the four manufacturers of ratlines were that hemp:

	Number		Number
Resists salt water	2	Resists weather	1
Use required by Government specifications	2	Is more available in the home market	1
Is stronger than jute	1	Resists rot	1
Is soft, pliable, flexible	1		

The manufacturers of houselines from hemp mentioned its resistance to salt water and rot, and its availability in the home market.

The only reason given for using hemp in shot lines was that it is required by Government specifications.

The manufacturer of hambrolines said he used hemp because it is easier to handle because of its softness and pliability, and that it is resistant to the effects of salt water.

Among companies who used hemp in industrial cordage, four manufacturers of hemp twines for tying springs said hemp:

	Number		Number
Has high knot-break strength	2	Ties a hard firm knot	2
Resists abrasion	2	Has good tensile strength	1
Resists pressure	2	Is cheap	1
Is not too elastic	2	Is soft, flexible, pliable	1

Three manufacturers of hemp wrapping twines gave as their reasons that hemp:

	Number		Number
Is strong	2	Ties a knot that holds	1
Is cheap	2	Is not too elastic	1
Is soft	1	Makes a uniform twine	1

The manufacturer of upholstery twines said he used hemp because it is long-wearing and strong.

A manufacturer who made meat twines from hemp said he used it because it is soft, yet strong, and ties a good knot.

A manufacturer of wire-rope centers said he used hemp because it has high break strength, is soft, does not disintegrate, and is clean.

A manufacturer of rope for the tying of hides said he used hemp because it is strong, does not cut your hands, is flexible, pliable, and ties easily, and it ties a hard, firm knot.

Reasons for using flax in various cordage products.-The major uses for flax were in fishing twines and twines for jacquard looms. Five companies manufactured the first product. They reported that they used it because flax:

	Number
Increases in strength when wet	4
Absorbs little water, doesn't swell	2
Is not too elastic	2
Permits good strength with small diameter	1
Lasts a long time	1
Doesn't stretch like nylon	1
Is cheaper to buy than nylon	1
Is cheaper to process than nylon	1
Is cheaper to process than cotton because it is twisted rather than braided	1
Is customarily used for this purpose	1

The three manufacturers of flax twines for use with jacquard looms said they used it because flax:

	Number
Is not too elastic	2
Has good tensile strength	1
Is soft	1
Is flexible	1
Spins a level even fiber	1
Is more durable than synthetics	1
Absorbs special finishes well	1

One manufacturer of upholstery twines said he used flax for this purpose because it has high knot-break strength, you can get good strength in a small size, and it is not too elastic.

A manufacturer of flax twines for use in gas-meter diaphragms said he used flax because it is not too elastic and is less subject to deterioration in coal-tar derivatives.

In the case of twines for use with scientific and measuring instruments, the manufacturer said he used flax because: It is long wearing, is not too elastic, and it doesn't stretch like nylon.

The manufacturer of flax twines for tying springs said it was particularly well-suited to this use because it is not too elastic, and also that it is customarily used for this purpose. This last reason was the only one given by the maker of flax twines for sealing money bags.

Fibers that have been used as substitutes for hemp and flax.-Manufacturers were asked whether they had ever used substitutes for flax and hemp in their products and, if so, what substitutes they had used. Among those who had made substitutions, jute and caroa were the fibers most often used to replace hemp, and hemp and nylon were the main substitutes for flax (table 22).

Table 22.-Fibers substituted for hemp and flax in cordage products

Fibers which have been substituted	Manufacturers who ordinarily used:	
	Flax	Hemp
	Number 1/	Number 1/
Nylon	2	1
Hemp	2	-
Jute	1	2
Ramie	1	-
Synthetic (unspecified)	1	-
Cotton	1	-
Flax	-	1
Sisalana	-	1
Number of manufacturers	4	3

1/ Frequencies add to more than total cases as most manufacturers used more than 1 substitute fiber.

Opinions regarding fibers used as substitutes for hemp and flax.-In general, soft-fiber manufacturers were not satisfied with the fibers they used in place of hemp and flax in their particular products. The responses reported here show the favorable and unfavorable comments made about each fiber.

Comments about fibers used in place of hemp:

Jute

Favorable	Number	Unfavorable	Number
Generally satisfactory	1	Not as strong as hemp	2
		Less durable than hemp	2
		Too soft	1

Flax

Generally satisfactory	1	Too expensive	1
Satisfactory as luxury item for yachts	1		

Sisalana

		Not as strong as hemp	1
		Too expensive	1
		Too stiff, not pliable	1

Nylon

Durable	1	Too expensive	1
Strong	1		

Comments about fibers used in place of flax:

Favorable	Number	Unfavorable	Number
Nylon			
Dries quickly	1	Elasticity too great	2
Resistant to salt water	1	Knots slip	1
		Too expensive	1
Hemp			
High break strength	1	Too coarse	1
		Too brittle	1
		Too expensive	1
Jute			
		Strength decreases when wet	1
		Poor in water resistance	1
		Will rot if not properly washed	1
Cotton			
Cheaper than flax	1	Less desirable than flax	1
Ramie			
Generally satisfactory	1	Too expensive	1

Fibers which manufacturers would most like to see developed as substitutes for hemp and flax.-No one fiber was chosen by a majority of manufacturers who ordinarily use either flax or hemp in their products as a desirable substitute for these fibers. Almost 3 in 10 specified jute as a substitute for hemp, and close to 4 in 10 selected American hemp as their preferred substitute for flax (table 23).

Table 23.-Fibers which soft-fiber manufacturers would like to see developed as substitutes for hemp and flax

Fibers	Proportion of soft-fiber manufacturers who mentioned a substitute for: Hemp	Proportion of soft-fiber manufacturers who mentioned a substitute for: Flax
	Percent [1]	Percent [1]
Jute	29	--
Flax	14	14
Kenaf	14	--
American hemp	--	38
Ramie	--	25
Nylon	--	13
None; not ascertained	43	38
Number of manufacturers	7	8

[1] Percentages add to more than 100 as some manufacturers expressed interest in more than 1 substitute for hemp and flax.

Reasons given by manufacturers for selecting particular fibers they would like to see developed as substitutes for hemp and flax.-Two manufacturers were interested in seeing jute developed as a possible substitute for hemp. The reasons they gave were: Have already had experience with it, it is soft and easy to handle, it's a long fiber, and it's cheaper than hemp.

The manufacturer who selected kenaf said it was because it would be available in the home market and cheaper than jute.

The one who had named flax commented that he had found flax generally satisfactory but gave no specific reason for his choice.

Three expressed interest in seeing American hemp developed as a substitute for flax. The reasons they gave were it is available in the home market, is generally satisfactory, and is more like flax than any other fiber.

Two suggested the development of ramie as a substitute for flax. They gave as their reasons that it is available in the home market, had experience with it, and it's a long-staple fiber.

One selected nylon as the fiber he would prefer to use as a substitute for flax. He gave specific reasons for his choice. They were that nylon has high break strength, ties a hard, non-slipping knot, resists abrasion, has good elasticity, is more rot resistant than flax, and is light in weight.

Opinions regarding the undesirable characteristics of hemp and flax.-About 4 in 10 soft-fiber manufacturers mentioned one or more undesirable characteristics in hemp or flax. In the case of hemp the chief complaint was that it is not well cleaned. The major criticism of flax was that it requires lengthy processing. Specific complaints are shown separately for hemp and flax below:

Undesirable characteristics of -

Hemp

	Number[1]		Number[1]
Is not well cleaned	3	Fiber is weak if not properly retted	1
Doesn't spin evenly	2	Is too brittle	1
Requires lengthy processing	1	No complaints about hemp	4
Requires well-humidified factories	1	Number of manufacturers who replied	7
Waste in processing amounts to 25 percent	1		

Flax

	Number[1]		Number[1]
Requires lengthy processing	3	Is not adaptable to as many end uses as nylon	1
Quality cannot be controlled	1	No complaints about flax	5
Has poor resistance to mildew	1	Number of manufacturers who replied	8
Foreign supply is unstable	1		

---

[1] Frequencies add to more than their totals as most manufacturers mentioned more than 1 undesirable characteristic of hemp or flax.

Experiences of soft-fiber manufacturers with American-grown hemp during World War II.-Soft-fiber manufacturers who ordinarily use hemp in the manufacture of cordage and twine products were asked whether they had used American-grown hemp during World War II and, if so, to describe their experiences with it. Thirty-five percent of the manufacturers said they had used home-grown hemp during the war and all of them commented about the fiber. The specific comments, classified into favorable and unfavorable, are shown below:

Favorable	No.[1]
Generally satisfactory in limited uses	5
Cheaper than imported hemp	5
Fairly strong	1
Soft	1
Easy to handle	1
Knots hold	1
Flexible; pliable	1
Resistant to abrasion	1
Available in home market	1
Superior to all foreign hemps except Italian	1
Number of manufacturers making favorable comments	6

Unfavorable	No.[1]
Poorly cleaned; contained chaff and tow	2
Required treatment for removal of dust	2
Poorly graded	1
Poor in color	1
Lacked uniformity	1
Too coarse, harsh	1
17-percent loss in processing	1
Required special treatment to make fine and pliable	1
Overretted, therefore brittle	1
More expensive than jute	1
Not as strong as Italian hemp	1
Domestic supply was small and uncertain	1
Number of manufacturers making unfavorable comments	6

Number of manufacturers who replied --- 6

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[1] The number of specific comments add to more than the totals because most manufacturers made more than 1 favorable and 1 unfavorable comment.

Cordage products reported made from kenaf by soft-fiber manufacturers.-Almost 2 in 10 soft-fiber manufacturers who make cordage and twine products said they used kenaf, mainly in wrapping twines. Other uses specified were: Marlines, ratlines, and houselines.

Cordage products reported made from urena lobata by soft-fiber manufacturers.-About 2 in 10 soft-fiber manufacturers who produce cordage and twine products said they used urena lobata, chiefly in farm twines and ropes. Other uses mentioned were: Wrapping twines, upholstery twines, marlines, ratlines, and ammunition box handles. The only reason given for using urena lobata in the end uses mentioned was that it is cheaper than jute.

Cordage products reported made from silk by soft-fiber manufacturers.-About 1 in 10 soft-fiber manufacturers of cordage and twine products said they had used silk for making fishlines. Reasons given for using silk for this purpose were that it takes a finish coating well, is soft, smooth, and flexible, and is traditionally used for fly lines.

Ramie

Opinions regarding possible use of ramie.-All soft-fiber manufacturers who produce cordage and twine products were asked their opinions regarding the possible use of ramie in their products. More than half made unfavorable comments about ramie; about 2 in 5 said they had had too little experience with or knowledge about this fiber to comment; and a fourth commented favorably.

The favorable comments were that ramie:

	Number[1]		Number[1]
Is a suitable substitute for flax	2	Is a suitable substitute for hemp	1
Is durable	2	Has good spinning qualities	1
Is adaptable to our machines	1		
Is a suitable substitute for jute	1	Number of manufacturers making favorable comments	5

The unfavorable opinions expressed were that ramie:

Is too expensive	4	Is not supplied in yarn form	1
Doesn't work well on our machines	2	Is more expensive than kenaf	1
Is not suitable for use in fishing lines	1	Is more expensive than either nylon or rayon	1
Does not braid well	1	Is better suited for use in woven fabrics	1
Is brittle	1		
Has low knot-break strength	1	Number of manufacturers making unfavorable comments	10
There is no consumer demand for it	1		

---

[1] Frequencies add to more than total cases as most manufacturers made more than 1 favorable and more than 1 unfavorable comment.

These same manufacturers were asked to indicate whether there were some uses for which ramie is better suited than others. Twelve percent said they thought ramie was best suited for use in wire-rope centers and rope generally. Reasons given were that ramie is very strong, uniform, and coarse.

Some comments made about ramie were:

> It has tremendous strength, good spinning qualities; it is a wonderful fiber. But from what I know about it now, it would not work in our machinery at all. If we could get it into a yarn we could certainly use it. (The respondent used jute for wrapping twines, farm twines, marline, ammunition box handles and also used some hemp).
>
> We would use it if there were public demand for it. I think it has good possibilities but nobody's pushed it. It can be used in place of linen and can last longer. It is more expensive than kenaf though.
>
> It is a good strong fiber. It has possibilities. It has the strength and I don't think it rots but it has never been raised in quantity. We used it some years ago. It is a good item and could be used if enough were available.
>
> We would not use it except to replace jute. But ramie is too limited in supply and its cost is much too high. I don't know enough about it to say more.

Nylon

About half of the soft-fiber manufacturers interviewed said they used nylon in their rope and twine products. Three-fourths of these companies produce twine from nylon, chiefly fishing twines. A fourth manufactured nylon cordage for industrial uses, and about a tenth made farm rope from nylon (table 24).

Table 24.-Proportion of soft-fiber manufacturers who used nylon in various cordage products in 1951

Cordage products	Proportion of soft-fiber manufacturers	
	Percent 1/	
Twine		75
Fishing	63	
Other--not specified	12	
Industrial cordage		25
Farm rope		12
Did not use nylon		53
Number of manufacturers	17	

1/ Percentages add to more than 100 as most manufacturers made more than 1 cordage product from nylon.

Those soft-fiber manufacturers who said they used nylon reported they had used 319,007 pounds in 1951. Close to 7 of every 10 pounds went into marine cordage and twine, and most of the remainder was used in industrial products, chiefly parachute cords.

Proportion of nylon reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of nylon used
Marine cordage and twine	68
Industrial cordage	27
Farm rope	5
Total	100
Number of pounds	319,007

Reasons for using nylon in various cordage products.-Manufacturers gave a number of reasons for using nylon in their cordage products and these varied depending upon the end use. Specific reasons given are shown for each cordage product separately.

Fishing twines

	No.1/		No.1/
Low rate of absorption; does not have to be dried after use; dries quickly	3	Resists abrasion	1
Resists rot	2	Light in weight	1
Resists fungus	2	Excessive elasticity can be controlled	1
Cheaper than silk	1	Number of manufacturers who replied	5

Parachute cords

Stronger than silk	1	Elasticity is good--lessens impact	1
More durable than silk	1	Number of manufacturers who replied	2
Low moisture absorption	1		

Farm rope

High tensile strength	1	Good elasticity	1
Resists abrasion	1	Number of manufacturers who replied	1

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using nylon.

Soft-fiber manufacturers who had used nylon were asked whether they felt nylon was better suited for some cordage uses than others. Almost half responded that they did not know, but about 4 in 10 said they felt that nylon is better for certain end products, specifically: Marine ropes, fishing twines, parachute cord, glider towing, towing generally, lariats, wrapping twines, and toys. Reasons given for these choices were that nylon -

Has great strength
Has strength without weight
Is easy to use; not hard on hands
Has low moisture absorption and does not require waterproofing
Has good elasticity
Is smooth
Is useful in easing impact of a towing operation
Is clean and stays clean
Has good durability
Is resistant to rot
Has excellent consumer acceptance
Is cheaper than silk

They were then asked their opinions regarding the utilization or further utilization of nylon in the cordage products they make. Almost 2 in 10 said they had no opinions about nylon because of lack of experience or knowledge of the fiber. But almost 8 in 10 made both favorable and unfavorable comments. These responses were:

Favorable

	Percent [1]		Percent [1]
Low moisture absorption	12	Resists the elements	6
Trend is toward synthetic fibers	12	Resists abrasion	6
Durable; long life	12	Resists fungus	6
Good consumer acceptance	12	Smooth	6
Good "feel"	12	Cheaper than silk	6
Resists rot	12	Eases impact in towing operations	6
Strong and light weight	12	Adaptable to soft-fiber machinery	6
Steady domestic supply	12	Braids well	6
Strong	6	Pliable	6
Dries quickly	6	Inert	6
Makes an attractive looking cord	6	Ties a hard, nonslipping knot	6
Good elasticity	6		
Uniform	6		
Stable price	6	Number of manufacturers who made favorable comments	11
Stronger than cotton	6		

Unfavorable

Priced too high at present	59	More expensive than rayon	6
Too elastic	6	Too harsh	6
More expensive than cotton	6	More expensive than jute	6
Deteriorates in sunlight	6		
Knot-break strength lower than natural fibers	6	Number of manufacturers who made unfavorable comments	11

---

[1] Percentages add to more than 100 as most manufacturers made more than 1 favorable or unfavorable comment.

Rayon

Three of the soft-fiber manufacturers interviewed said they used rayon in their cordage products: Two in the production of novelty tying twines, and one in parachute cords. These two uses accounted for 116,844 pounds of rayon consumed during 1951. Reasons given for using rayon in novelty tying twines were that it dyes easily and takes bright colors well, is not too elastic, and is uniform. With respect to its use in parachute cords, manufacturers said rayon is strong enough for the purpose, is cheaper than nylon, and meets Government specifications.

Orlon

Soft-fiber manufacturers were asked to express their opinions regarding the possible utilization of orlon in their cordage products. More than a third said they did not know enough about orlon to have opinions about it; all but one of the respondents made critical comments. The one manufacturer who favored orlon said he thought it would make a good substitute for nylon. The unfavorable comments were that orlon:

	Percent 1/
Is too expensive to buy	29
Is not as strong as nylon	6
Is not strong enough	6
Has a low knot-break strength	6
Would necessitate production changes that would be costly	6
Is harder to dye than nylon	6
Doesn't make a good tying twine because it is hard to break	6
Total proportion who made unfavorable comments	59

1/ Percentages add to more than the total as some manufacturers made more than 1 comment.

Istle

Of the soft-fiber manufacturers who make cordage and twine products 29 percent said they used istle, either palma or pita floja. Most companies that use istle use it in making twine, chiefly wrapping twine (table 25).

Table 25.-Proportion of soft-fiber manufacturers who used istle in various cordage products in 1951

Cordage products	Soft-fiber manufacturers	
	Number 1/	
Twine		4
Wrapping	3	
Upholstery	2	
Tying vegetables	1	
Marlines	1	
Rope		2
Childrens' jump ropes	1	
Ratlines	1	
Number of manufacturers	5	

1/ Frequencies add to more than total cases since some soft-fiber manufacturers made more than 1 cordage product from istle.

These companies said they used 1,267,410 pounds of istle during 1951. About half of the total number of pounds used went into twines for household use and half into industrial twines, heavy wrapping twines, upholstery twines, and marlines.

Proportion of istle reported used in various cordage and twine products in 1951 is listed below:

Cordage and twine products	Percentage of istle used
Household twines	50
Industrial twines	49
Farm twines	1
Total	100
Number of pounds	1,267,410

Reasons for using istle in various cordage products.-The chief reason given by soft-fiber manufacturers for using istle, regardless of end product, was that it is cheaper than jute. The three who reported its use in wrapping twines said, for example, that they used it because istle:

	No.		No.
Is cheaper than jute	3	Ties easily and well	1
Is stronger than jute	1	Has superior yardage per pound	1

The manufacturer who used it in making marlines and farm twines said his only reason for using istle was that it is cheaper than jute.

One of the two manufacturers of upholstery twines said he used istle in this product because it is cheaper than jute, and the other said he used it because its color is better than that of jute and his product, therefore, can compete better with upholstery twines made from Italian flax.

One manufacturer made jump ropes and one made ratlines from istle. Both said they used istle because it is cheaper than jute.

Factors Considered in Selecting Fibers for Soft-fiber Industry

Soft-fiber manufacturers were asked to list all the things about a fiber that they would consider in making a choice between two fibers. Results show that price comes first, adaptability to soft-fiber machinery second, and tensile strength third:

		Pct. 1/
Price considerations; cost of raw material		35
Adaptability to machines, production facilities		29
Tensile strength		29
High tensile strength	23	
High knot-break strength	6	
Strength for size	6	
Characteristics of fiber		18
Pliability; flexibility	12	
Clean	12	
Good "feel in hands"	6	
Soft	6	
Length of fiber	6	
Color of fiber	6	
Way in which packed	6	
Dependable source of supply		18

		Pct. 1/
Durability		12
Resistance to abrasion	12	
Resistance to water, moisture	6	
Characteristics of processing		12
Ability to take dye	6	
Ability to absorb oil	6	
Elasticity		12
Less elasticity	6	
Not defined	6	
Estimate of consumer acceptance		12
Whether it would produce a more attractive product		6
Quality of end product		6
Not ascertained		60
Number of manufacturers who replied		17

1/ Percentages total to more than 100 as some manufacturers mentioned more than 1 thing they would consider in selecting a fiber.

Special Problems of the Soft-fiber Industry

About 2 in 5 of the soft-fiber manufacturers interviewed said they had some trouble in getting the fibers they wanted in the quality and quantity wanted. These fibers were:

	Number		Number
American hemp	5	Kenaf	1
Silk	1	Jute	1
Istle	1		

Problems described for each of the fibers listed were:

American hemp	Number
It must be contracted for a year in advance	4
No longer grown in this country	2
Manufacturer now forced to subsidize farmer	2
Not produced in sufficient quantities	1

Silk	
Not graded as to quality; poor fiber now mixed with better grades	1

Istle	
Can't get it because of the Mexican embargo	1

Kenaf	
Still in the experimental stage. Unpredictable quality and quantity	1

Jute	
Quantity limited because of trouble between India and Pakistan	1

It may be noted that about 3 in 10 manufacturers of soft fiber would be interested in American-grown hemp.

MANUFACTURERS OF COTTON CORDAGE AND TWINE PRODUCTS

Cotton

Manufacturers of cotton cordage and twine products used 63,994,501 pounds of lint cotton and 29,150,734 pounds of cotton waste in 1951. More than 7 out of every 10 pounds of lint cotton went into industrial cordage and twine. The major end use for cotton waste was household twines (table 26).

Table 26.-Proportion of lint cotton and cotton waste reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion of lint cotton used	Proportion of cotton waste used
	Percent	Percent
Industrial cordage and twine	72	29
Farm cordage and twine	14	28
Household twines	10	43
Marine cordage and twines	4	-
Total	100	100
Number of pounds	63,994,501	29,150,734

More than 4 in 5 manufacturers of cotton cordage interviewed said they made industrial cordage and twine products from cotton; more than 2 in 5 make household twines. More than a third manufacture farm rope, and about 3 in 10 produce fishing or marine cordage (table 27).

Table 27.-Proportion of manufacturers of cotton cordage who made different type of cordage from cotton in 1951

Cordage products	Proportion of manufacturers of cotton cordage	
	Percent 1/	
Industrial		81
Twine	36	
Cord	31	
Rope	26	
Household twines		41
Farm		35
Rope	31	
Twine	20	
Fishing and marine		30
Fish lines	20	
Fish nets	13	
Seine twine	10	
Rope	3	
Number of cases	39	

1/ Percentages (left column) add to more than their subtotals (right column) and these add to more than 100 as most manufacturers made more than 1 type of product from cotton.

Cotton in industrial twines.-More than a third of the cotton used by manufacturers of cotton cordage and twine goes into industrial twines. These include masons' chalk lines, tag and toy twines, twines for netting (other than marine), meat twine, twines for gas masks, mattresses and springs. Manufacturers said they used cotton yarns and lint cotton almost exclusively in these end products.

A variety of reasons were given for using cotton in these products. They are listed as follows:

Masons' chalk lines	Number [1]
Priced right; cheaper than synthetics; cheaper than other natural fibers; cheap enough so product is expendable	5
Strong enough for requirements	3
Flexible, pliable	3
Soft	2
Holds chalk; not slippery	2
Resists abrasion, pressure	2
Ties easily; ties a better knot	1
Smooth; not rough or splintery	1
Resists weather, elements	1
White, clean looking	1
Available in home market	1
No suitable replacement at present	1
Number of manufacturers who replied	7

Toy twines	Number [1]
Cheap; cheaper than flax, hemp, other fibers	3
Flexible, pliable, easily coiled, packaged	3
Strong; strong enough for requirements	2
Can be mildew proofed	1
Smooth; won't cut hands	1
Easy to process	1
High knot-break strength	1
Looks good	1
Resists abrasion	1
Runs smoothly; doesn't knot	1
Can be made in fine numbers	1
Number of manufacturers who replied	6

Tag twines	Number [1]
White, clean appearance	3
Flexible, pliable	2
Higher knot-break strength	1
Can be mildew-proofed	1
Easy to process	1
Blends well with synthetics	1
Ties easily; ties a better knot	1
Smooth; not rough, splintery	1
Can be run in fine numbers	1
Cheapest fiber available	1
Number of manufacturers who replied	4

Netting (other than fish nets)	
Cheaper than synthetics	2
Resistant to sunlight	1
Have specialized in it	1
Number of manufacturers who replied	2

One manufacturer used cotton in meat-tying twines. He gave as his reasons that cotton:

Has high knot-break strength
Is smooth
Is flexible, pliable
Is white, clean looking
Looks sanitary

---

[1] Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

In the case of gas-mask twines, the one manufacturer who reported gave as his reasons that cotton:

- Can be mildew-proofed
- Can be rot proofed
- Is smooth
- Is flexible and pliable

This manufacturer gave the same reasons for using cotton in spring-tying twines.

A manufacturer of cotton-tying twine for mattresses said he used cotton because it:

- Is strong enough for requirements
- Is easy to process
- Is soft
- Is cheaper than nylon
- Makes a uniform twine; spins and twists easily

Cotton in industrial cords.-About 3 in 10 manufacturers said they made industrial cords from cotton. Most of this cord was reported made from cotton yarn and lint cotton but use of cotton waste and mixtures of yarn with waste was also reported. This cord went into many different end products. The major products were clothesline, sash and venetian blind cord, awning and motor-starter cord, and signal-bell cord. Reasons given by manufacturers for using cotton in these particular end products follow:

Clothesline	Number [1]
Flexible, pliable	7
Smooth; doesn't cut hands	6
Cheaper than synthetics	5
Can be polished, sized	4
Long-wearing, durable	4
Doesn't stain	4
Strong; strong for its size; strong enough for requirements	4
Can be treated against water damage	3
Soft	3
Not subject to dry rot	3
Can be mildew-proofed	3
Not as much stretch as in synthetics	3
Cheaper than other natural fibers	3
Looks good	2
Has no suitable replacement at present	2
Available in home market	2
Can be rot-proofed	1
Easy to process	1
Cheaper than ramie	1
Cheapest fiber	1
Resists weather; the elements	1
Not too elastic	1
Resists abrasion	1
Runs smoothly over pulleys, doesn't catch	1
Number of manufacturers who replied	13

Window sash cord	Number [1]
Runs smoothly over pulleys, doesn't catch	6
Resists abrasion	4
Strong; strong for its size; has the required strength	4
Not too elastic	3
Cheap; cheaper than synthetics, hard fibers, or ramie	3
Easy to process	1
Long-wearing, durable	1
Available in home market	1
Not as much stretch as synthetics	1
Number of manufacturers who replied	7

(continued)

Awning cords	Number 1/
Strong; strong enough for requirements	5
Durable, long-wearing	4
Available in home market	4
Runs smoothly over pulleys; pliable	4
Cheaper than synthetics, other natural fibers, or ramie	3
Can be mildew-proofed	2
Resistant to weather	1
Have always specialized in it	1
Number of manufacturers who replied	7

Venetian blind cord	Number 1/
Runs smoothly over pulleys; doesn't catch	6
Cheap; cheaper than nylon, hemp, flax, aralac	5
Resists abrasion	3
Strong enough for requirements	3
Have specialized in it	2
High knot-break strength	1
Available in home market	1
Looks good	1
Number of manufacturers who replied	6

Tent and tarpaulin cord	Number 1/
Strong; strong enough for requirements	4
Available in home market	4
Smooth	3
Flexible, pliable	3
Firm; holds shape when wet	3
Not too elastic	3
Knots don't slip	3
Resists water	3
Cheap; cheaper than synthetics, hemp, other natural fibers	3
Can be mildew-proofed	2
Resistant to weather	1
Number of manufacturers who replied	6

Motor-starter cord	Number 1/
Available in home market	4
Smooth	3
Flexible, pliable	3
Elastic	3
Strong enough for requirements	1
Can be mildew-proofed	1
Cheaper than synthetics, hemp, or other natural fibers	1
Resists abrasion	1
Runs smoothly in grooves	1
Number of manufacturers who replied	5

Signal and bell cords	Number 1/
Elastic	3
Smooth	3
Flexible	3
Available in home market	3
Strong enough for requirements	2
Resists abrasion	2
Runs smoothly in grooves	2
Number of manufacturers who replied	5

Window shade cord	Number 1/
Cheap; cheaper than synthetics, other fibers	3
Flexible, pliable	2
Durable, long-wearing	2
Strong enough for requirements	1
Have specialized in it	1
Soft	1
Looks good	1
Number of manufacturers who replied	3

Safety device cord	Number 1/
Smooth	3
Flexible, pliable	3
Available in home market	3
Elastic	3
Number of manufacturers who replied	3

Drapery cord	Number 1/
Resists abrasion	2
Runs smoothly over pulleys	2
Cheap; cheaper than nylon or aralac	2
Strong enough for requirements	1
Soft	1
Looks good	1
Number of manufacturers who replied	2

Specialty and novelty cords	Number 1/
Cheaper than synthetics	2
Ties easily; ties a better knot	1
Flexible, pliable	1
Smooth, doesn't cut hands	1
Resists abrasion	1
Strong enough for requirements	1
Number of manufacturers who replied	2

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

A manufacturer of cable cords for garments said he preferred cotton for this use because:

It can stand applications of high heat
It can be sanforized with fabric

A manufacturer of upholstery piping gave as reasons for using cotton that it:

Can be mildew-proofed
Is cheaper than other fibers
Is available in the home market

One manufacturer said he made cotton cord for rug looms. He said he used cotton for this purpose because it:

Can be mildew-proofed
Can be rot-proofed
Is smooth; not splintery
Is flexible, pliable
There is no suitable replacement for it

Cotton in industrial rope.-About 1 in 4 manufacturers interviewed said they made cotton rope for industrial purposes. Almost all of this rope was made from cotton yarn or lint cotton; almost no cotton waste was reported used. Manufacturers gave the following reasons for using cotton:

Stage setting and curtain ropes	Number 1/
Strong enough for the purpose	3
Runs smoothly on pulleys	3
Elastic	3
Available in home market	3
Number of manufacturers who replied	3

Power-transmission rope	Number 1/
Cheaper than synthetics	1
Durable, long-wearing	1
Elastic	1
Specialize in it	1
Number of manufacturers who replied	2

Wire-rope centers	Number 1/
Resists abrasion	1
Can be kept within a closer tolerance than jute	1
Not too much stretch	1

Wire-rope centers (continued):	Number 1/
Stronger than twisted paper	1
Cheaper than synthetics	1
Number of manufacturers who replied	2

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

A manufacturer who said he used cotton in miners' well ropes and tillers' ropes because it:

Resists abrasion
Runs smoothly over pulleys
Is strong enough for requirements

Another said he made cotton mule bandings (rope for textile mills) because the cotton:

Doesn't cut the hands
Runs smoothly over pulleys
Is cheaper than jute
Is easy to process

Still another who made cotton rope for miscellaneous industrial purposes, said that cotton:

Is cheaper than other natural fibers
Doesn't cut the hands

Cotton in wrapping and packaging twines.-About 2 in 5 manufacturers of cotton cordage interviewed made some sort of wrapping or tying twine from cotton. Much packaging twine is made from cotton waste, although some manufacturers used cotton yarn or lint cotton or a mixture of one of these with waste cotton. Reasons given for using it were that it is:

	Number 1/
Cheap; cheaper than synthetics, flax, hemp, ramie; cheap enough to be expendable	14
Smooth; not rough or splintery; does not cut hands	10
Strong; strong enough for requirements	8
High knot-break strength	6
Looks good, attractive	5
Ties easily; ties a better knot	5
Flexible, pliable	4
No suitable replacement at present	4
Easy to break in tying process	3
Not too elastic	3
Easy to process	2
Long-wearing; durable	2
Doesn't stretch as much as synthetics	2

	Number 1/
Adaptable to our machines; a short fiber	1
Available in home market	1
Doesn't slip; stays in place	1
Resists water	1
Doesn't stain	1
Sanitary	1
White	1
Less subject to mildew than jute	1
Superior yardage per pound	1
Number of manufacturers who replied	23

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

Cotton in marine cordage.-Three in 10 manufacturers of cotton cordage sampled produced fishing twines or rope; 1 in 5 made fishing lines; about 1 in 10 fish nets or seine twine; and a negligible proportion made fishing ropes. Almost no cotton waste goes into these products. Respondents gave a variety of reasons for using cotton in these products:

Fishing twines, nets	Number 1/
Cheap; cheaper than synthetics, flax, silk, or other fibers ----------	14
Strong; strong enough for requirements	3
Can be treated to prevent water damage -------------	3
Moderate absorption of water; not too heavy when wet ---	2
Can be rot-proofed --------	2
Can be tarred ------------	1
Smooth; not rough or splintery; doesn't cut hands -------------------	1
Flexible, pliable ---------	1
Resists weather, the elements ----------------	1
Resists abrasion ----------	1
(Fishing twines, nets continued)	Number 1/
Resists sunlight ----------	1
Holds shape when wet ------	1
Meshes lock better --------	1
Number of manufacturers who replied -------------	11

Fishing rope	Number 1/
Cheap; cheaper than hemp, synthetics --------------	2
Maintains strength when wet	1
Resists water ------------	1
Resists abrasion ----------	1
Moderately absorbent; dries quickly -----------	1
Not too elastic -----------	1
Number of manufacturers who replied -------------	4

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

Cotton in farm rope and twine.-More than a third of the manufacturers produced twine and rope for farm use. A sizable quantity of cotton waste is used for this purpose, particularly in farm ropes. Manufacturers of farm twines said they are used for tying vegetables, flowers, etc., and that cotton is particularly suitable because it:

	Number 1/
Is cheap; cheaper than synthetics, flax, hemp, other natural fibers; cheap enough for product to be expendable ----------------	8
Strong enough for requirements ----------------------	5
Doesn't stain --------------	2
Soft; doesn't cut crops -----	2
Less subject to rot than jute ----------------------	2
Can be weather-proofed ------	1
Doesn't cut the hands -------	1
Easier to break in the tying process -----------	1
Ties easily; ties a good knot --------------------	1
Flexible, pliable ---------	1
Resists abrasion ----------	1
Available in domestic market -----------------	1
Number of manufacturers who replied ------------	8

1/ Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

Manufacturers of plowlines said they used cotton because it:

	Number [1]
Does not cut hands; smooth; soft	11
Is cheap; cheaper than synthetics, other natural fibers	10
Strong enough for requirements	7
Smooth	4
Is customarily used; habit	2
Can be mildew-proofed	1
Ties easily; ties a better knot	1
Resists water	1
Available in home market	1
Not as much stretch as nylon	1
Number of manufacturers who replied	11

---

[1] Frequencies add to more than their totals as most manufacturers gave more than 1 reason for using cotton.

Four manufacturers of cotton well rope said they liked cotton for this purpose because it:

	Number
Is smooth; does not cut the hands	4
Is cheap; cheaper than synthetics or other natural fibers	4
Available in home market	4
Is customarily used for this	2
Can be mildew-proofed	1

Three who made cotton rope for general farm use said they used cotton because it:

	Number
Is strong enough for most farm purposes	2
Resists abrasion	1

Some comments made by cotton manufacturers regarding the use of cotton in their own products follow.

One northern respondent who used a mixture of cotton yarn with cotton waste for wrapping twines said:

> It has a high knot break, has a good feel on handling to the hand, good appearance and does not mildew as quickly as jute.

The same respondent who used the mixture in clotheslines said:

> Cleanliness, no stain on clothes, good appearance, just enough give to cotton to hold the clothes pins. In the outdoor clothesline there is a long stretch between points and cotton has enough elasticity to handle that stretch without being too much and is strong enough to handle the weight.

A northern manufacturer who used cotton yarn in tag twines said:

> We use both rayon and cotton in our tag twines; about 70 percent is cotton. We find cotton extremely satisfactory to the trade. It has been used so long that the industry is slow to change to a new fiber. Primarily the industry got greatest yardage from rayon but it did not accept it. We experimented with glass but the knot strength of glass is 20 percent against 80 percent for cotton. I'm quite sure there is enough strength in glass for the industry but they don't know it.

A manufacturer who used a mixture of cotton yarn and cotton waste in braided cords and wrapping twine said he preferred the mixture:

> Because the blend is pliable, strong, it lasts a long time and it is smooth. No other fiber could take its place. It is also comparatively cheap in comparison to synthetics and fibers like ramie. The synthetics stretch more than cotton and cannot be snapped easily. All of these cords and twines (sash cord, awning cord, clotheslines, and wrapping twines) must be smooth, even the sash cord which is handled least because it must run over pulleys. Waste helps keep the cost down and the yarn makes these products smooth and with all the stretch that is required of them.

A northern manufacturer of farm rope from cotton waste said:

> The biggest thing is the price; I can't think of any other fiber that would be better suited. The second object is strength and until a cotton line begins to rot it has the strength the farmer wants; besides he wouldn't pay more money even if we gave him more strength or a line that wouldn't rot. A plow line should be easy on the hands, strong, and resistant to rot. A synthetic fiber rope wouldn't rot but it would be more expensive; a hard fiber would make a stronger rope but it would be hard on the hands.

A southern manufacturer who used lint cotton for tag cords said he liked cotton for this use because:

> Cotton cords run well on the tagging machine while a harder twine might not. It is also easy to tie a loop in cotton twine; and its appearance - it is white and clean looking.

A southern manufacturer of chalk lines from lint cotton said:

> The main thing is that it is cheap so you can afford to use it and throw it away. It is soft and flexible and for that reason is easy to unravel and wind up again. And it will hold chalk which synthetics will not.

A comment from a southern manufacturer who used lint cotton for sash cord was:

> It is strong for its size and is cheaper than a similar size rope made from synthetics or other fibers.

A comment from a southern manufacturer who used lint cotton for wrapping twine:

> You have got a reasonably priced item and an item that you can break with the hand without cutting. The synthetics have too high a break and are too high in price for wrapping twine.

A manufacturer who used lint cotton in seine twine and trot lines said:

> It is mainly price; the only selling point to synthetic seine twine is that you get more yardage with less break, but it still does not compete with cotton because of its price. Too, cotton does not deteriorate too badly in water. In trot lines cotton absorbs some water but that is not a disadvantage because it does not absorb enough to make the line heavy.

Fibers that have been used as substitutes for cotton.--Among the cotton manufacturers interviewed 1 in 5 said he had tried a substitute for cotton at some time. Most of these respondents had substituted rayon for cotton; a few had tried nylon, jute, vinyl plastic, and fiber glass. These respondents were asked to describe how the substitute fibers had worked out. The responses are shown below, classified as favorable or unfavorable for each fiber:

Rayon

Favorable	Number 1/	Unfavorable	Number 1/
Stronger than cotton	3	Lower knot-break strength than cotton	5
More decorative than cotton	2	Too slippery	4
Cheaper than cotton	1	Less resistant to water	3
More stable in price	1	Too soft; flattens out	2
Superior yardage per pound	1	Strength decreases when wet	1
		Cuts the hands	1
		Less resistant to abrasion	1
		Does not run smoothly over pulleys	1
		High degree of absorption	1
		Doesn't dye as well as cotton	1
		Too elastic	1
		Less yardage per pound	1

Number of manufacturers who replied ---------- 6

Nylon

Favorable	Number 1/	Unfavorable	Number 1/
Strong	1	Too expensive	1
Not too elastic	1		

Number of manufacturers who replied ---------- 2

Fiberglas

Favorable	Number[1]	Unfavorable	Number[1]
Strong	1	Less resistance to abrasion	1
Cheaper than nylon	1	Does not run smoothly over pulleys	1
Not too elastic	1		

Number of manufacturers who replied ---------- 1

---

[1] Frequencies add to more than total cases as most manufacturers made more than 1 favorable or unfavorable comment.

The cotton manufacturer who had used jute as a substitute for cotton said he had used it because the price of the raw fiber was lower, but that he found there was less profit for him in the finished product.

One respondent who had used vinyl plastic in place of cotton did not give his opinions concerning it.

Opinions regarding further utilization of cotton.- All manufacturers interviewed were asked to give their opinions regarding further utilization of cotton in the cordage industry. Fifteen percent of the manufacturers of cotton cordage said they believed there might be further uses for cotton in their products. They were asked to specify the products and explain why they thought cotton might be used. None of the respondents could list any specific end products, but all could give reasons for feeling that, with the help of research, further uses might be found. These reasons were:

Its price is relatively competitive with other fibers
Our mills are especially adapted to its use
It is generally durable and has good weaving qualities
It is generally more durable than the synthetics
It is not affected by extreme cold
It takes a dye particularly well
Treatments now being developed may give it further uses

Most cotton manufacturers felt that cotton is now used as extensively as is possible in the cordage industry. They were asked to explain why they felt cotton could not be more fully utilized. The main response was that as cotton is one of the oldest fibers, all possible end uses must have been tried by this time. Almost 2 in 3 manufacturers gave this response. Other reasons given by smaller proportions of the respondents were:

Synthetics are taking the place of cotton in superior ways
It is limited as to strength
Other fibers are cheaper
It is classed as an expensive line
Plastics are more durable and better looking
Other natural fibers are more durable
Other natural fibers are more flexible
Cotton is too short a staple
It has too much elasticity

Other Fibers Used

Only 1 percent of the fibers consumed by cotton manufacturers is made up of negligible amounts of other natural fibers and synthetics. These other natural fibers are chiefly jute and istle twine, flax, and silk.

Jute is used mainly in wrapping twines; small quantities are also used in clotheslines, sash cord, and awning cord.

Istle twines are used exclusively in clotheslines; flax and silk are used only in fishing lines (table 28).

Table 28.-Proportion of other natural fibers reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion used			
	Jute	Istle Twine	Flax	Silk
	Percent	Percent	Percent	Percent
Wrapping twine	70	-	-	-
Clothesline	19	100	-	-
Window sash cord	2	-	-	-
Awning cord	9	-	-	-
Fishing lines	-	-	100	100
Total	100	100	100	100
Number of pounds	136,000	97,729	15,600	12,000

Jute

Eight percent of the cotton manufacturers interviewed said they used some jute in their industrial cordage products. They gave as their reasons for using jute in:

Wrapping twines	Number [1]
It is strong enough for this purpose	3
It is cheap	2
It looks attractive	1
Just habit; customarily use it	1
Number of manufacturers who replied	3

Clotheslines	Number [1]
It is strong enough for this use	1
It is cheap	1
It is not too elastic	1
Number of manufacturers who replied	1

---

[1] Frequencies add to more than total cases as most manufacturers gave more than 1 reason for using jute.

Two of the three manufacturers who ordinarily use jute in their products said the fiber has certain undesirable characteristics from their viewpoint. These were:

It is not always cleaned well, and if it is not carded properly it retains small splinters of wood.

When it is combined with cotton, the rough fiber often cuts through the cotton.

It is somewhat rough. It can be made smooth by oiling; but the oiling makes it unacceptable for use in clotheslines.

Flax

Two cotton manufacturers interviewed reported they used flax in making fishing lines. They said they prefer flax for this use because it:

Resists salt water
Strength increases when wet
Is generally more satisfactory than cotton

Istle

Two cotton manufacturers said they used istle twine in making clotheslines. They gave as reasons for using istle twine in this product that it:

Is stronger than cotton
Is strong for its size
Is cheaper than cotton
Is flexible
Has less stretch to it than cotton
Is resilient

Opinions of cotton manufacturers regarding the outlook for kenaf in their industry.-Cotton manufacturers were asked whether they thought kenaf might be adapted to uses in the cordage industry. Four in 5 of those interviewed said they did not know enough about kenaf to have an opinion. Among those with opinions concerning kenaf, most were negative toward its use in the industry. Unfavorable comments made about kenaf were that it:

Is too rough, harsh, hairy
Cannot be spun in fine enough numbers
Is too expensive to process
Has less yardage per pound for the required strength, is therefore more expensive
Is not suited to our products
Is too heavy for twines
Is better suited to hard-fiber machinery

Opinions regarding possible use of ramie.-Cotton manufacturers were asked what they thought about further utilization of ramie in the cordage industry. Nearly half of those interviewed said they did not know enough about ramie to have opinions concerning it. Among those who had opinions, the majority were unfavorable toward its use. They said that it:

Is too expensive
Is grown in very limited quantities. Little is available
Would require changes in their machinery
Is a rough, splintery, harsh fiber
Is difficult to handle
Is too costly to convert or spin
Will break in a bending process
Is too strong for a tying twine
Is not uniform as to fiber
Is damaged by chemical cleaning
Is difficult to process; to remove the woody part
Has less yardage per pound
Is rigid
Is better adapted to hard-fiber machinery
Is too expensive to compete with rayon or nylon
Doesn't make as smooth a yarn as cotton
Is too slippery to hold a knot
Is too hard on the hands to be used in venetian blind cord, plow ropes, or tying twines
Is not suitable for use in fishing lines
Is not suitable for use in parachute cords

Those who favored the use of ramie in the cordage industry gave as their reasons that it:

Resists rot
Has high tensile strength
Is stronger than cotton
Has good straight-break strength

Is durable; long-wearing
Would make a good wrapping twine

Could compete with cotton in industrial uses
Could compete with nylon in industrial uses

Would be a good substitute for flax in cordage products
Would be a good substitute for jute in cordage products

Nylon

Almost 1 in 4 manufacturers of cotton cordage interviewed said they used some nylon in their products. A total of 232,259 pounds were reported used by these respondents in 1951. About a fourth of the nylon was used in industrial cordage, mainly for parachute cords; but the bulk was used in fishing cordage: fishlines and gill fish nets (table 29).

Table 29.-Proportion of nylon reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion of nylon used	
	Percent	
Fishing		75
Fishing lines	45	
Gill fish nets	30	
Industrial		23
Parachute cord	19	
Tennis string	3	
Miscellaneous [1]	1	
Household and other		2
Venetian blind cord	2	
Total	100	
Number of pounds	232,259	

---

[1] Includes motor-starter cords.

Reasons for using nylon in various cordage products.-Thirteen percent of the cotton manufacturers interviewed said they produced nylon fishing twines. The reasons they gave for using nylon were that it:

	No.[1]
Is strong for its size; greater strength in smaller sizes	4
Has a low absorption rate; does not have to be dried after use	3
Does not require treatment with preservatives	2
Is resistant to fungus, marine growths	2
Resists abrasion	1
Resists mildew	1
Is not damaged by water	1
Is transparent, therefore it catches more fish	1
Has high straight-break strength	1
Has great public acceptance; has had a good promotion program	1
Number of manufacturers who replied	5

---

[1] Frequencies add to more than total cases as most manufacturers gave more than 1 reason for using nylon.

A manufacturer of nylon venetian blind cord said he used nylon because it is stronger than cotton, more durable than cotton, and more attractive looking than cotton--has a sheen.

One manufacturer of nylon parachute cords gave the following reasons: Nylon is strong for its size; has greater strength in small diameters and its elasticity is an asset because it lessens the impact the jumper receives when the parachute is opened.

A manufacturer who made nylon motor-starter cords said he liked the nylon because it is more durable and gives greater life to the cord.

Cordage and twine uses for which nylon is best suited.-Manufacturers were asked whether there were certain cordage and twine uses for which nylon is better suited than others. Three-fourths said they felt that nylon was particularly good for these end uses:

	Pct.[1]		Pct.[1]
Parachute cords	31	Oil-rigging cable	3
Fishing twines	31	Mule bandings	3
Marine uses--general	14	Mountain climbers' ropes	3
Glider towing	10	Motor-starter cord	3
Towing--general	10	Clothesline	3
Wrapping and tying twine	10	Venetian-blind cord	3

Number of manufacturers who replied ----- 29

---

[1] Percentages add to more than 100 as most manufacturers mentioned more than 1 possible cordage use for nylon.

Opinions regarding possible use of nylon.-Manufacturers were asked to give their opinions regarding the possible use of nylon in their own products. Two percent felt they knew too little about nylon to have opinions. Most of those who expressed opinions made both favorable and unfavorable comments, but tendency toward favoring the fiber was strong. The comments, classified as favorable and unfavorable, are listed below:

Favorable

	Pct. [1]		Pct. [1]
Great strength	45	Resists abrasion	2
More durable than cotton	23	Resists fungus, marine growth	2
Good strength without weight, bulk	17	Doesn't stretch, returns to original shape	2
Low moisture absorption	17	Can now be treated for elasticity	2
Does not require drying	8	Smooth	2
Makes an attractive looking product	7	Size can be controlled easily	2
Better breaking strength than cotton	5	Fibers are lightly fused	2
Has great elasticity	5	Does not require sizing or finishing	2
Fibers have great uniformity	5	Clean	2
The price is stable	5	Less waste	2
Does not require frequent tarring, cleaning, or preservatives	5	Dyes well	2
Resists mildew	5	Cheaper than silk	2
The long-range price is cheaper	5	High price of cotton gives it advantage	2
Good knot-break strength	2	Good for heavy-duty jobs	2
Stronger than silk	2	Transparency makes it good for fish nets	2
Resists the elements	2	Spun nylon has many of the characteristics of cotton	2
		Total proportion who made favorable comments	92

Unfavorable

	Pct.[1]
Too expensive to buy at present	53
Too elastic; must be treated to lessen stretch	25
Greater strength than most products require	20
More expensive than cotton	18
Deteriorates in sunlight	12
Too slippery; smooth; slick	10
Would not run over our machines, which are especially adapted for cotton	8
Loses strength when wet	5
Doesn't hold a knot well	5
Knot-break strength lower than natural fibers	5
More waste than with cotton	5
Loses strength when stretched	2
Not suitable for vegetable-tying twines--cuts the vegetables	2
Gets fuzzy	2
Greater durability than needed for some products, such as those used seasonally	2
Wears longer; therefore, less cord is sold	2
Supply is limited	2
Won't absorb finishes	2
Has too much static	2
Cuts needles	2
Fibers are brittle	2
More expensive than rayon	2
Total proportion who made unfavorable comments	74
No opinion	2
Number of manufacturers	39

---

[1] Percentages add to more than their subtotals and subtotals add to more than 100 as most manufacturers made more than 1 favorable or 1 unfavorable comment.

Rayon

Manufacturers of cotton cordage used 164,602 pounds of rayon during 1951 in various cordage products. The major uses for rayon were industrial (table 30).

Table 30.-Proportion of rayon reported used in various cordage and twine products in 1951

Cordage and twine products	Proportion of rayon used	
	Percent	
Industrial		75
Tag and calendar cord	44	
Twines--unspecified	17	
Wrapping twines	14	
Cords--unspecified	[1]	
Parachute cord	[1]	
Household and other		25
Cords--unspecified	17	
Venetian blind cord	8	
Total		100
Number of pounds	164,602	

[1] Less than 1 percent.

Reasons for using rayon in various cordage products.-Fifteen percent of the companies interviewed in the study reported the use of rayon in some of their cordage products. Two respondents who used rayon for novelty tying twines, tag, and calendar cord said they liked it because it is stronger than cotton, looks more attractive, decorative; it has a sheen, costs about the same as cotton, and yields superior yardage per pound.

A manufacturer of rayon venetian blind cord gave the same reasons.

One manufacturer who used rayon in parachute cord gave as his reasons that it is strong enough for use in a bomb parachute, and it is cheaper than nylon.

Orlon

Manufacturers were asked their opinions regarding the use of orlon in their own products. About 2 in 5 said they knew too little about this fiber to have any opinions regarding its use. Among those who had definite opinions, some expressed both favorable and unfavorable ones; the majority, however, were unfavorable. The responses are shown below classified by whether they are favorable or unfavorable toward the use of orlon.

Favorable

	Pct.1/		Pct.1/
Great tensile strength; great strength for its size, weight	22	Resistant to mildew	5
Elastic	8	Durable; long-wearing	5
Resistant to sunlight	8	Resistant to weather	2
Makes an attractive product	5	Stainless; stays clean	2
		Total proportion who made favorable comments	33

Unfavorable

Not a cordage fiber, more like wool; more like a textile fiber	22	Elastic recovery not as great as nylon	5
Too expensive	15	Loses 20 percent of its strength when wet	2
Not as strong as nylon	12	It has more strength than is required for most products	2
Price is too high for products to meet competition	8	It must be twisted four or five times to get necessary strength	2
More expensive than cotton	8	Too hard to break in tying process	2
Machinery production procedures are not adapted to it	7	Too coarse for fishing lines or parachute cords	2
Not strong enough; low knot-break strength	5		
Not resistant to abrasion	5		
It has no properties to make it superior to nylon	5	Total proportion who made unfavorable comments	61

No opinion ------------- 41

Number of manufacturers who replied ----------- 39

1/ Percentages add to more than their subtotals and subtotals add to more than 100 as some manufacturers made more than 1 favorable or 1 unfavorable comment.

Factors Manufacturers of Cotton Cordage Would Consider in Selecting Cordage Fibers

Manufacturers of cotton cordage were asked to specify the various factors they would weight in choosing between any two fibers. Results show that price, adaptability to machinery, and particular characteristics of the fiber are the major factors in such a decision. The responses are shown below:

	Percent [1]	
Price considerations		44
Cost of raw material	36	
Price stability	8	
Whether the fiber is cheaper than cotton	3	
Adaptability to machines		36
Whether the fiber could be run over present machinery with present production procedures	20	
Cost and extent of conversion that would be necessary	20	
Fiber characteristics		29
Strength--must be high	29	
Practicability in processing (not get fuzzy, hairy, fray out)	10	
Resistance to abrasion	8	
Elasticity--not too great	8	
Resistance to weather	5	
Durability	5	
Ability to take dye	5	
Pliability; flexibility	5	

		Percent [1]
Fiber characteristics (cont'd)		
Resistance to rot	5	
Ability to take a preservative; a finish	5	
Resistance to water, moisture	3	
High degree of absorbency	3	
Elasticity--great	3	
Resistance to flexual fatigue	3	
Good "feel in hand"	3	
Smoothness	3	
Uniformity	3	
Estimate of consumer acceptance		28
Dependability of source of supply		5
Appearance of product		5
Competitors' use of other fibers		5
Number of manufacturers who replied		39

---

[1] Percentages add to more than their subtotals and these add to more than 100 as most manufacturers mentioned more than 1 factor.

Special Problems of Manufacturers of Cotton Cordage

Fifteen percent of the cotton cordage manufacturers interviewed said they had problems in getting certain of the fibers they used. These fibers were cotton, nylon, and flax.

Three manufacturers described their problems in getting cotton thus: Some mills or speculators are holding high-quality waste for a higher price. There is a shortage of 1 inch fibers, and I have had to take 1-1/16 inch and 1-1/32 inch. Large companies are having trouble because the Government bought up the good cotton and shipped it to Italy, France, and Germany. The high price of cotton forces the use of cotton waste.

The manufacturer who said he had trouble getting flax said it was because Belgian Courtrai is not being produced. Farmers are now growing the white seed because the yield is better; the blue seed was superior.

Two manufacturers who said they had trouble getting nylon said it had been placed on allotment because of trouble in Korea.

APPENDIX TABLES

Table 31.-Fibers used in cordage products by hard fiber cordage and twine industry, 1951

Product	Total	Abaca	Lint cotton	Hemp	Henequen	Sisalana
	Percent	Percent	Percent	Percent	Percent	Percent
Baler twine ----------	40	4	--	--	24	76
Industrial cordage and twine 1/ -------	21	25	100	9	20	18
Marine cordage 2/ ----	13	37	--	23	3/	3/
Binder twine ---------	13	3/	--	--	54	5
Farm rope ------------	5	12	--	16	2	1
Government orders ----	3	8	--	--	3/	3/
Fishing cordage and twine 4/ -----------	3	7	--	52	3/	3/
Oil and gas well cable --------------	2	7	--	--	--	3/
Miscellaneous uses 5/-	3/	3/	--	--	--	--
Total -----------	100	100	100	100	100	100
	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.
Total number of pounds --------------	272,584	94,383	30	246	57,316	120,609

1/ Includes such things as antenna rope, construction rigging rope and hoisting rope.

2/ Includes such things as anchor line, falls for anchor, hoisting rope and net cargo.

3/ Less than 1 percent.

4/ Includes such things as bow line, dock line, ladder rope and lashing rope.

5/ Includes such things as clothesline and heart rope for wire rope centers.

Table 32.-Fibers used by the cotton cordage and twine industry in the manufacture of cordage products, 1951

Product	Total	Lint cotton	Waste cotton	Flax	Jute	Rayon	Nylon	Orlon	Silk	Istle twine
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Industrial	57	72	29	--	71	75	23	100	--	--
Wrapping twine	43	55	26	--	71	14	--	--	--	--
Twine 1/	4	5	1	--	--	--	--	--	--	--
Industrial twine (not further specified)	2	3	--	--	--	--	--	--	--	--
Twine (not further specified)	2	3	--	--	--	17	--	--	--	--
Cordage 2/	2	3	3/	--	--	--	--	--	--	--
Industrial rope (not further specified)	2	2	--	--	--	--	--	--	--	--
Chalk and mason line	1	3/	3/	--	--	--	--	--	--	--
Twisted cotton rope	1	3/	2	--	--	--	--	--	--	--
Tying twine	3/	3/	--	--	--	--	--	--	--	--
Tag twine	3/	--	--	--	--	17	--	--	--	--
Wire center cord	3/	3/	--	--	--	--	--	--	--	--
Cord for toys	3/	3/	--	--	--	--	--	--	--	--
Cotton center bell cord	3/	3/	--	--	--	--	--	--	--	--
Specialty braided cord	3/	3/	--	--	--	--	--	--	--	--
Kite cord	3/	3/	--	--	--	--	--	--	--	--
Parachute cord	3/	--	--	--	--	3/	18	--	--	--
Tag and calendar cord	3/	--	--	--	--	27	--	--	--	--
Industrial cord (not further specified)	3/	--	--	--	--	3/	2	--	--	--
Tent rope	3/	--	3/	--	--	--	--	100	--	--
Power transmission rope	3/	1	--	--	--	--	--	--	--	--
Mule banding	3/	3/	--	--	--	--	--	--	--	--
Tennis string	3/	--	--	--	--	--	3	--	--	--

Continued

Table 32.-Fibers used by the cotton cordage and twine industry in the manufacture of cordage products, 1951 -continued

Product	Total	Lint cotton	Waste cotton	Flax	Jute	Rayon	Nylon	Orlon	Silk	Istle twine
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Household and other	22	10	43	--	29	25	2	--	--	100
Sash cord, clothesline, awning 4/	8	2	19	--	--	--	--	--	--	--
Venetian blind cord	5	4	5	--	--	8	2	--	--	--
Window sash cord	4	1	9	--	2	--	--	--	--	--
Clothesline	2	1	5	--	18	--	--	--	--	100
Braided cord 5/	2	--	5	--	--	--	--	--	--	--
Braided cord 6/	1	2	--	--	--	--	--	--	--	--
Window shade cord	3/	3/	--	--	--	--	--	--	--	--
Awning cord	3/	3/	3/	--	9	--	--	--	--	--
Awning rope	3/	--	3/	--	--	--	--	--	--	--
Drapery cord	3/	3/	--	--	--	--	--	--	--	--
Cable cord	3/	--	--	--	--	--	--	--	--	--
Cords	3/	--	--	--	--	17	--	--	--	--
Farm	19	14	28	--	--	--	--	--	--	--
Farm twine	16	1	23	--	--	--	--	--	--	--
Farm rope, plow lines	3	13	5	--	--	--	--	--	--	--
Fishing	2	4	3/	100	--	--	75	--	100	--
Seine twine	2	3	3/	--	--	--	--	--	--	--
Trot lines	3/	3/	3/	--	--	--	--	--	--	--
Fishing lines	3/	3/	3/	100	--	--	45	--	100	--
Fishing rope	3/	1	3/	--	--	--	--	--	--	--
Gill fish nets	3/	--	--	--	--	--	30	--	--	--
Total	100	100	100	100	100	100	100	100	100	100
	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.
Total number of pounds	93,884	63,994	29,151	16	136	164	232	81	12	98

1/ Includes wrapping twine, seine, twine, trotlines.
2/ Includes sash cord, tag cord, chalk lines, clotheslines.
3/ Less than 1 percent.
4/ Includes yo-yo cords and cable cords.
5/ Used for awning cord, tent rope, clotheslines and for starting motors.
6/ No breakdown, but used for venetian blinds, drapes, shades.

Table 33.-Fibers consumed in the manufacture of miscellaneous products by cordage and twine manufacturers using cotton or a synthetic fiber primarily, 1951 [1]

Product	Total	Lint cotton	Waste cotton	Flax	Rayon
	Percent	Percent	Percent	Percent	Percent
Carpet yarn, scatter rug yarn, warp	21	23	--	--	--
Insulating yarn	15	17	12	--	--
Hose belt cord	15	18	--	--	--
Tufting yarn	11	6	42	--	--
Sewing twine for bags	9	10	--	--	--
Paper makers felts	8	10	--	--	--
Crochet and knitting yarns	6	2	--	--	100
Mops, mop yarn, mop heads	4	2	22	--	--
Fire hose yarn	3	4	--	--	--
Sales yarn	3	1	16	--	--
Weaving yarn	3	3	--	--	--
Rug fillers	1	2	--	--	--
Piping cord	1	--	8	--	--
Tubular braid	[2]	1	--	--	--
Trimming and braid	[2]	1	--	--	--
Filtration cord	[2]	--	--	100	--
Total	100	100	100	100	100
	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.
Total number of pounds	18,606	15,502	2,403	1	700

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[1] Since this information was not specifically asked for, but volunteered by the companies interviewed in the sample, it is probably incomplete both with respect to quantity of fibers used and noncordage and twine products manufactured.

[2] Less than 1 percent.

Table 34.-Fibers used by the soft fiber cordage and twine industry in the manufacture of cordage products, 1951

Product	Total	Jute	Lint cotton	Flax and Hemp	Hemp	Istle	Sisal	Flax	Urena lobata	Nylon	Rayon
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Industrial	1/ 54	76	--	--	62	49	--	30	--	27	100
Twine	26	38	--	--	14	20	--	11	--	--	--
Cordage and twine (not further specified)	1/ 23	32	--	--	48	4	--	19	--	27	100
Electrical cord	2	2	--	--	--	--	--	--	--	--	--
Tube rope	2	2	--	--	--	--	--	--	--	--	--
Ammunition box rope	1	1	--	--	--	25	--	--	--	--	--
Rove twine	2/	1	--	--	--	--	--	--	--	--	--
Sliver	2/	2/	--	--	--	--	--	--	--	--	--
Household and other	42	21	96	100	35	50	100	--	100	--	--
Twine	26	6	94	44	--	--	87	--	--	--	--
Cordage and twine (not further specified)	12	15	--	--	35	50	--	--	100	--	--
Rove	4	--	--	56	--	--	--	--	--	--	--
Household and kite twine	2/	--	2	--	--	--	--	--	--	--	--
Household and wrapping twine	2/	2/	--	--	--	--	--	--	--	--	--
Lariat and clothesline	2/	--	--	--	--	--	13	--	--	--	--
Indoor line	2/	--	2/	--	--	--	--	--	--	--	--
Farm	2	3	--	--	--	1	--	--	--	5	--
Rope	1	2	--	--	--	--	--	--	--	--	--
Twine	1	1	--	--	--	1	--	--	--	5	--
Fishing and marine	3/ 2	2/	4	--	3	--	--	70	--	68	--
Fish netting	1	--	4	--	--	--	--	40	--	19	--
Fish lines	1/ 1	--	2/	--	--	--	--	30	--	27	--
Marine cordage (not further specified)	2/	2/	--	--	3	--	--	--	--	17	--
Fishing cordage and twine (not further specified)	2/	--	--	--	--	--	--	--	--	5	--
Total	3/100	100	100	100	100	100	100	100	100	100	100
	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.
Total number of pounds	68,307	45,477	13,844	4,200	2,116	1,268	379	360	227	319	117

1/ Includes 700 pounds of silk. 2/ Less than 1 percent. 3/ Includes 700 pounds of silk used for fish lines.

Table 35.-Fibers consumed by the soft fiber cordage and twine industry in the manufacture of miscellaneous products, 1951 1/

Product	Total	Jute	Lint cotton	Flax	Ramie	Rayon	Nylon
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Thread	41	--	85	83	--	--	--
Carpet yarn	26	51	--	--	--	--	--
Electric yarn	15	29	--	--	--	--	--
Carpet back yarn	8	15	--	--	--	--	--
Sliver	6	--	13	--	--	--	--
Electrical roves	3	5	--	--	--	--	--
Shoe thread	1	--	2/	7	--	--	--
Lacing twine	2/	--	--	5	--	15	--
Household rugs	2/	--	1	--	--	--	--
Mop heads	2/	--	1	--	--	--	--
Pile and upholstery yarns	2/	--	--	--	--	75	--
Weaving yarns	2/	--	--	3	--	--	--
Specialty sewing thread	2/	--	--	2	--	--	--
Mops	2/	--	2/	--	--	--	--
Roving	2/	--	--	--	100	--	--
Webbing yarn	2/	2/	--	--	--	--	--
Ribbon	2/	--	2/	--	--	10	--
Gillings	2/	--	--	--	--	--	97
Garland	2/	--	2/	--	--	--	--
Industrial wire	2/	--	--	--	--	--	3
Total	100	100	100	100	100	100	100
	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.	1000 lbs.
Total number of pounds	35,296	17,668	15,318	2,159	35	100	16

1/ Since this information was not specifically asked for, but volunteered by the companies interviewed in the sample, it is probably incomplete both with respect to quantity of fibers used and noncordage and twine products manufactured.

2/ Less than 1 percent.